DOCUMENT RESUME

ED 252 409 SE 045 331

AUTHOR Thoman, John; Moser, James
TITLE Competencies for Mathematics Shelf Tests. Wisconsin Competency-Based Testing Program. Bulletin No. 5184.
INSTITUTION Wisconsin State Dept. of Public Instruction, Madison.
REPORT NO CBT/DPI-11/1/84
PUB DATE Nov 84
NOTE 89p.
PUB TYPE Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Competency Based Education; Criterion Referenced Tests; Elementary Secondary Education; *Mathematics Education; *Mathematics Instruction; *Minimum Competency Testing; Quantitative Tests; State Departments of Education; *Test Construction; *Test Items
IDENTIFIERS Competency Based Testing Program; *Wisconsin

ABSTRACT

This booklet contains the competencies, item specifications, and sample items for the mathematics competency tests developed by the Wisconsin Department of Public Instruction for administration at grades 3, 7, and 10. Commonly referred to as the "shelf tests," they will be available for the first time during the 1985-86 school year. Ten competencies for grade 3, 12 for grade 7, and 12 for grade 10 are first listed. They then, for each competency, are given a brief description, sample items, content description, suggested number of items, and recommendations on question form and response form. (MNS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED252409

SCOPE OF INTEREST NOTICE

The Eric Facility has assigned this document for processing to: SE

In our judgment, this document is also of interest to the Clearinghouses noted to the right. Indexing should reflect their special points of view EA

Mathematics Competencies for Shelf Tests

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

✓ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Wisconsin Competency-Based Testing Program

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

L. Harmatuck

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

September 1984

Wisconsin Department of Public Instruction
Herbert J. Grover, State Superintendent

SE 035 331

Division for Instructional Services

John Benson, Assistant State Superintendent

Bureau for Assessment and Testing
Thomas J. Stefonek, Director

Pupil Competency Testing Section
Norman Webb, Chief

Pupil Competency Testing Staff:

John C. Bell
Maggie Burke
Frank Evans
Rajah Farah
Darwin Kaufman
Barbara Nesemeyer
John Thoman
Nancy Whaley

Bureau for Program Development
Arnold M. Chandler, Director

Curriculum Development Section
Eunice Bethke, Chief

Curriculum Development Staff:

Benjamin Brewer
Donald Chambers
Doris M. Cook
Ellen Last
James Moser
Elizabeth VanderSchaaf

Word Processing Operators:

Leah Dobrinen
Cindy Sellnow

Competencies for Mathematics Shelf Tests

Wisconsin Competency-Based Testing Program

John Thoman
Shelf Test Development Coordinator

James Moser
Competency-Based Testing Mathematics Supervisor

November 1984

The Department of Public Instruction does not discriminate on the basis of race, sex, age, religion, handicap,or national origin.

Bulletin No. 5184

TABLE OF CONTENTS

	Page
Preface	v
Acknowledgments	vi
Competencies 3, 7, 10	1
Grade 3 General Description	5
Grade 3 Item Specifications	6
Grade 7 General Description	29
Grade 7 Item Specifications	30
Grade 10 General Description	56
Grade 10 Item Specifications	58

PREFACE

This booklet contains the competencies, item specifications, and sample items for the mathematics competency tests. These tests were developed by the Department of Public Instruction for administration at grades three, seven, and ten. The tests, commonly referred to as the "shelf tests," will be available for the first time during the 1985-86 school year.

CBT Program Legislation

The Wisconsin Competency-Based Testing Program was established by legislation in 1981 and 1982. The program is administered by the Department of Public Instruction for Wisconsin school districts that volunteer to participate. The legislation specifies that participating districts are to administer a competency-based test in each of the content areas of reading, language arts, and mathematics once in grades 1, 2, 3, or 4; once in grades 5, 6, 7, or 8; and once in grades 9 or 10. There are four sources of tests that districts may use: DPI-developed tests (shelf tests), DPI item bank, commercial tests, and locally-developed tests. The items included on the shelf tests will be in the item bank.

Chapter 243, Laws of 1981, requires that participating districts submit tests adopted by the school board to the State Superintendent for approval. Competencies, performance standards, and levels to be tested within the specified grade spans are to be defined with the active involvement of administrators, teachers, and parents. Special education students may be tested based on local board policy and the needs of the individual student. Limited-English speaking students may be tested within the guidelines established by department administrative rules.

Test Development and Format

A content development committee consisting of school teachers, administrators, and university professors assumed a central role in identifying competencies, item specifications, and test items to be included in the DPI-developed pupil competency tests (shelf tests) in mathematics. Participating school districts provided input on the importance, appropriateness, and clarity of these competencies through teacher surveys and field testing the test items. The shelf test competencies were selected to reflect the mathematics curricula of participating school districts and to have integrity within the community of mathematics educators.

Each competency on the shelf tests will have at least six test items used to assess student skills and knowledge. For each grade level, the test will be divided into two parts with each part requiring one class period to administer. The results of the tests will be reported for each individual student by competency and by total test score.

Testing Schedule

Two administration periods for 10th grade and one administration period for 3rd and 7th grades have been identified. The following schedule includes the release and administration dates for each grade:

Important Dates to Remember

10th Grade Test	
November 11, 1985	Test will be released by the DPI
November 11 - December 6, 1985	First administration period
March 24 - April 18, 1986	Second administration period
3rd & 7th Grade Tests	
March 24, 1986	Tests will be released by the DPI
March 24 - April 18, 1986	Administration period

ACKNOWLEDGMENTS

CURRICULUM DEVELOPMENT COMMITTEE - Members

Judith Brower
Silver Lake College
Manitowoc

Gail Burrill
Whitnall High School
Greenfield

Arnie Engebretsen
Greendale High School
Greendale

Ruth Gundermann
Randall Elementary School
Madison

Mary Herrick
Arbor Vitae-Wood Elementary School
Woodruff

Pat Huston
Wauwatosa West High School
Wauwatosa

Pat Lautenschlager
Sabish Junior High
Fond du Lac

Berland Meyer
Longfellow School
Wausau

Kenneth Richert
Arrowhead High School
Hartland

Billie Sparks
University of Wisconsin
Eau Claire

Gene Wagner
Maple Dale School
Milwaukee

DPI staff members:

Don Chambers
Frank Evans
James Moser
John Thoman
Norman Webb

SHELF TEST PLANNING COMMITTEE--MEMBERS

Russell Allen
Department of Public Instruction

Eunice Bethke
Department of Public Instruction

Anna Biermeier
(Affirmative Action Officer)
Department of Health and Social Services

Gail Burrill
Greenfield

Donald Chambers
Department of Public Instruction

Doris M. Cook
Department of Public Instruction

Ben Brewer
Department of Public Instruction

Frank Evans
Department of Public Instruction

Darwin Kaufman
Department of Public Instruction

John Koehn
Oconomowoc

James Moser
Department of Public Instruction

Thomas J. Stefonek
Department of Public Instruction

Michael J. Subkoviak
University of Wisconsin
Madison

John Thoman
Department of Public Instruction

Neil Vail
Racine

Elizabeth VanderSchaaf
Department of Public Instruction

Ezequiel Vargas
(Supervisor of Bilingual/Bicultural Education)
Department of Public Instruction

Norman Webb
Department of Public Instruction

Grade 3 Mathematics Competencies

3.1 The student will be able to recognize pictorial, numerical, and word representations of whole numbers and fractions.

3.2 The student will be able to add and subtract whole numbers.

3.3 The student will be able to determine solutions for number sentences.

3.4 The student will be able to identify squares, rectangles, triangles, and circles.

3.5 The student will be able to use drawings, tables, or graphs to represent or solve problems.

3.6 The student will be able to use addition and subtraction to solve problems in applied situations.

3.7 The student will be able to identify wanted, given, and needed information in a problem statement.

3.8 The student will be able to read instruments for measuring length, time, temperature, capacity, and weight.

3.9 The student will be able to identify appropriate units for measuring length and time.

3.10 The student will be able to recognize equivalent measures and use them to add and subtract measures of length, time, and money.

Grade 7 Mathematics Competencies

7.1 The student will be able to recognize equivalent representations of whole numbers and decimals expressed in words, in conventional notation, in expanded notation, or in exponential notation.

7.2 The student will be able to add, subtract, multiply, and divide whole numbers and decimals.

7.3 The student will be able to determine solutions for number sentences including equalities and formulas.

7.4 The student will be able to identify common geometric figures and relationships.

7.5 The student will be able to read and interpret tables and graphs.

7.6 The student will be able to use addition, subtraction, multiplication, and division to solve problems in applied situations.

7.7 The student will be able to solve problems that can be solved by procedures such as looking for a pattern, constructing a table, using guess and check procedures, or using a drawing.

7.8 The student will be able to determine the length, area, volume, and angle measure of common geometric figures.

7.9 The student will be able to round numbers and to estimate the results of addition, subtraction, multiplication, and division of whole numbers, decimals, and fractions.

7.10 The student will be able to recognize equivalent representations of rational numbers expressed as fractions, decimals, or percents.

7.11 The student will be able to add, subtract, and multiply fractions and mixed numbers.

7.12 The student will be able to determine the probability of a simple event.

Grade 10 Mathematics Competencies

10.1 The student will be able to recognize equivalent representations of whole numbers, decimals, and fractions expressed in conventional notation, in exponential notation, or as percent.

10.2 The student will be able to use the rules for order of operations to find a value for an expression.

10.3 The student will be able to evaluate formulas and to solve proportions, linear equations, and linear inequalities with one variable.

10.4 The student will be able to identify similar and congruent figures and determine measures based on similarity and congruence.

10.5 The student will be able to read, interpret, and make inferences from tables and graphs.

10.6 The student will be able to use addition, subtraction, multiplication, and division to solve problems in applied situations.

10.7 The student will be able to solve problems that can be solved by procedures such as looking for a pattern, constructing a table, using guess and check procedures, or making a drawing.

10.8 The student will be able to calculate the length, perimeter, area, volume, or angle measure of common geometric figures.

10.9 The student will be able to order a given set of real numbers.

10.10 The student will be able to determine the outcome of an algorithm (e.g. set of instructions, flow chart, and program) or modify an algorithm to produce a specified outcome.

10.11 The student will be able to solve problems in applied situations involving percent.

10.12 The student will be able to determine the probability of a simple event and to use elementary statistics to describe data.

GRADE 3
MATHEMATICS ITEM SPECIFICATIONS

SUBJECT: Mathematics
GRADE LEVEL: 3

GENERAL ITEM SPECIFICATIONS

1. Readability will be below Grade 3 level.

2. Problem content, particularly word problems, will be of interest to and relevant for Grade 3 students.

3. Although scratch paper will be available, when possible, sufficient room to work directly on the item will be provided.

4. Occasionally, descriptions of the question form will also apply to the response form and vice versa; for example, restrictions for labeling geometric figures generally apply whether the figure is part of the stem or a response.

5. Each competency will be measured by six test items.

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.1

The student will be able to recognize pictorial, numerical, and word representations of whole numbers and fractions.

BRIEF DESCRIPTION

The student is expected to know that whole numbers less than 1,000 and proper fractions less than one can be represented by symbols, by words, and by pictures. If given a representation in one of these forms, the child should be able to pick out an equivalent representation in one of the other forms.

SAMPLE ITEMS

1. Which number is the same as 4 hundreds + 2 tens + 0 ones?

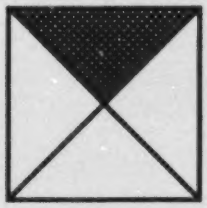
   *A 420
   B 402
   C 240
   D 42

2. Which number means <u>one third</u>?

   *A 1/3
   B 3/1
   C 1
   D 3

3. What fraction describes the shaded part of this figure?

   A 1/3
   *B 1/4
   C 3/4
   D 4/1



CONTENT

1. Recognition of different representations involves taking a number in any one of these modalities (pictorial, numerical, or word) and choosing from among either of the other two modalities a correct representation. That is,

picture → numerical	numerical → picture	words → picture
picture → words	numerical → words	words → numerical

2. Place value concepts will be included <u>per se</u> as an aspect of representation of whole numbers.

3. Whole numbers will be less than 1,000.

4. Number words will be less than <u>twenty</u>.

5. Fractions will have denominators of 2, 3, or 4, and will be less than 1.

SUGGESTED NUMBER OF ITEMS

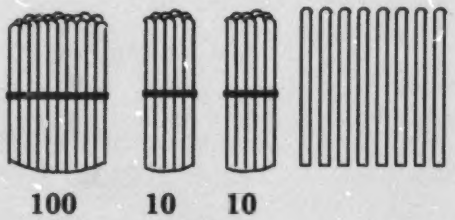
whole numbers (to include as a subset, place value concepts per se)	4
fractions	2

QUESTION FORM

1. Representations of whole numbers may include:

   a) number words — 128 is one hundred, two tens, and eight ones
   128 is 1 hundred, 2 tens, and 8 ones

   b) pictures of counting sticks — 128:



   c) expanded notation — 128 = 1 hundred + 2 tens + 8 ones
   128 = 100 + 20 + 8

   Note: 1 x 100 + 2 x 10 + 8 x 1 will not be used. Regrouped forms such as 12 tens + 8 ones will not be used.

2. Zero will be used in some items.

3. Representation of fractions will include number words and pictures of simple geometric figures such as circles or rectangles with shaded and unshaded parts.

4. When fractions are represented by geometric figures, it will be specified whether questions pertain to the shaded or unshaded areas.

5. When fractions are represented by geometric figures, the figure(s) will be divided equally into only the number of parts specified by the denominator(s) of the fraction(s). For example, if the fraction is 3/4, the figure will be divided into 4 equal parts, not 8, 12, 16, etc.

RESPONSE FORM

NOTE: The question characteristics above also pertain to responses since some items will be presented in reverse form. (See #1 above in Content.)

1. All responses for a particular item will be in the same modality of representation; distractors will be improper representations (when the stem is a number) or improper numbers (when the stem is a representation).

2. Distractors for whole numbers may include numbers greater than 999 and references to the thousands' place.

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.2

The student will be able to add and subtract whole numbers.

BRIEF DESCRIPTION

The student is expected to be able to use familiar computational algorithms for addition and subtraction with two- and three-digit numbers, particularly when the numbers in the tasks require regrouping (carrying and borrowing).

SAMPLE ITEMS

1.
```
  583
+ 228
```
A 701
B 711
C 801
*D 811

2.
```
   73
 -27
```
A 56
B 54
*C 46
D 44

3.
```
   26
   39
+ 18
```
A 73
B 82
*C 83
D 92

CONTENT

1. Addition problems will be restricted to:

   a. 2 or 3 two-digit addends,
   b. 2 three-digit addends,
   c. 1 two-digit and 1 three-digit addend,
   d. Sums less than 1,000.

2. Subtraction problems will be restricted to:

   a. 2 two-digit or 2 three-digit numbers,
   b. 1 three-digit and 1 two-digit number,
   c. positive solutions.

3. Most items require regrouping.

SUGGESTED NUMBER OF ITEMS

addition	3
subtraction	3

of which: 1 is without regrouping, 5 are with regrouping
4 are without zeros, 2 are with zeros

QUESTION FORM

1. Problems may be presented in vertical or horizontal format.

2. Some problems will have zeroes.

3. Items with regrouping will be varied systematically so that regrouping is required:

   a. in ones place only,
   b. in tens place only, and
   c. in both ones and tens places.

RESPONSE FORM

1. Distractors will include the result of regrouping errors such as failure to regroup, carrying to or borrowing from the wrong place, or carrying the wrong digit (primarily column addition).

2. Distractors for subtraction problems will include the result(s) of subtracting the smaller number(s) from the larger instead of regrouping.

3. Most distractors will be the result of incorrect use of algorithm(s) rather than of random errors in basic addition or subtraction facts.

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.3

The student will be able to determine solutions for number sentences.

BRIEF DESCRIPTION

The student is expected to be able to determine solutions to simple "open sentences" such as 5 + ☐ = 13 or 7 = 15 − ☐ where the solution can be found by relating the problem to basic-fact combinations of addition and subtraction, and where sums and minuends are 18 or less.

SAMPLE ITEMS

1. Which number goes in the box?

   14 = 8 + ☐

   A 22
   B 14
   *C 6
   D 5

2. Which number goes in the box?

   ☐ − 8 = 5

   A 3
   B 5
   *C 13
   D 18

3. Which number goes in the box?

   ☐ + 7 = 13

   *A 6
   B 7
   C 13
   D 20

CONTENT

1. Number sentences will be restricted to horizontal, symbolic statements of the general form:

	Left-hand Sentences		Right-hand sentences
Addition	a + b = c	or	c = a + b
Subtraction	a − b = c		c = a − b

They will be so-called "open sentences" because a box (☐) will be used to represent a missing number in each. The boxes will appear only in the "a" or "b" positions of the sentences (equations) written above.

2. Sums ("c" in the above addition sentences) or minuends ("a" in the above subtraction sentences) will be whole numbers no larger than 18.

SUGGESTED NUMBER OF ITEMS

addition sentences	3		right-hand sentences	3
subtraction sentences	3	and	left-hand sentences	3

QUESTION FORM

1. Open number sentences will be given with the question: "Which number goes in the box?"

RESPONSE FORM

1. Distractors will include the results of simply adding or subtracting the two numbers in the sentence.

2. Some distractors will be 1 higher or 1 lower than the correct answer.

SUBJECT: Mathematics
GRADE LEVEL: 3

COMPETENCY 3.4

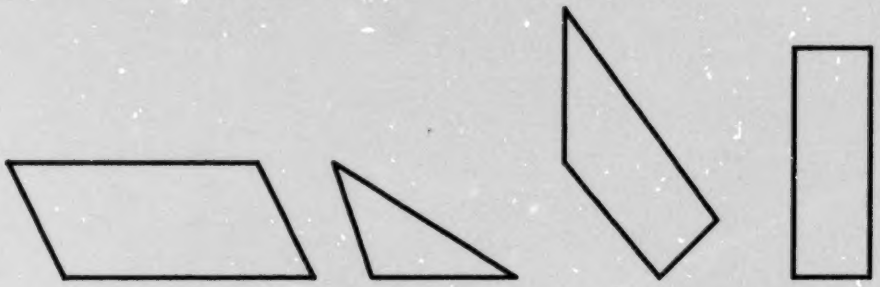
The student will be able to identify squares, rectangles, triangles, and circles.

BRIEF DESCRIPTION

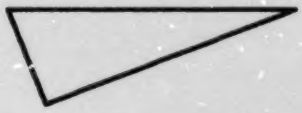
The student is expected to be able to associate the picture of a square, rectangle, triangle, or circle with the name of that geometric figure. The association is to be made in either of two ways -- given a picture, tell the name or given a name, choose the picture.

SAMPLE ITEMS

1. Which shape is a rectangle?



2. Name the shape.



A cube
B rectangle
C square
*D triangle

CONTENT

1. Figures will be restricted to squares, rectangles, triangles, and circles.

2. Identification requires:
   a. Providing the name when a figure (or figures) is given, or
   b. Choosing the figure when a name is given.

SUGGESTED NUMBER OF ITEMS

square	1 or 2		figure to name	3
rectangle	1 or 2	and	name to figure	3
triangle	1 or 2			
circle	1			

QUESTION FORM

1. All items require figures (if not in stem, then in responses).
2. Figures will be placed in various orientations.
3. Figures will be of various sizes.
4. No letter labels or other marks will appear on the figures.

RESPONSE FORM

1. Distractors will include figures other than squares, rectangles, triangles, circles. Some three-dimensional figures may be used.
2. The characteristics for the question will apply when figures are used in the responses.

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.5

The student will be able to use drawings, tables, or graphs to represent or solve problems.

BRIEF DESCRIPTION

The student is expected to be able to extract information from a graphical display, such as a picture, table, or graph. The displays are relatively simple and contain, at most, 20 pieces of information. Graphs are limited to bar graphs and pictographs, with no reading of a scale required.

SAMPLE ITEMS

1. How many tickets did Jim sell on Thursday?

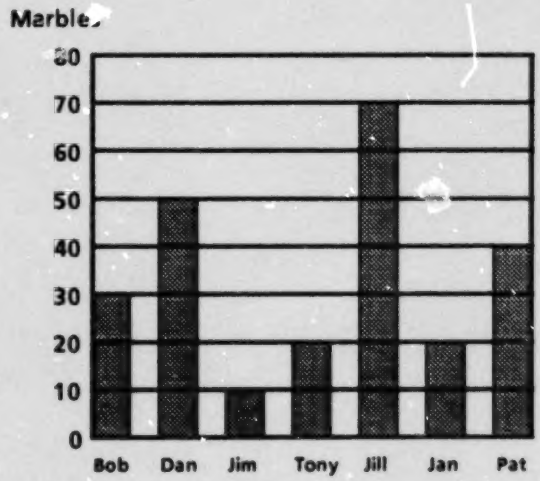
A 28
B 27
C 17
*D 15

TICKETS SOLD

Day	Pat	Jim
Monday	25	22
Tuesday	20	17
Wednesday	19	28
Thursday	27	15
Friday	28	30

2. Which child has the fewest marbles?

A Dan
*B Jim
C Jill
D Pat



3. Which table best represents the problem?

John won 1 red and 2 blue ribbons.
Jill won 5 red and 4 white ribbons.
Jane won 3 blue and 3 white ribbons.
Which color ribbon did the children win most?

Ribbons Won

Child	Red	Blue
John	1	2
Jill	5	4
Jane	3	3
Total	9	9

A

Ribbons Won

Child	Red	Blue	White
John	1	2	
Jill	5		4
Jane		3	3
Total	6	5	7

*B

Ribbons Won

Child	Red	Blue	White
John	1	2	
Jill	5		4
Jane	3		3
Total	9	2	7

C

Ribbons Won

Child	Red	Blue	White
John	1	2	
Jane		3	3
Total	6	5	7

D

CONTENT

1. To represent a problem graphically would ordinarily mean to construct an appropriate drawing, table, or graph as a model of numerical information contained in a problem statement. Here the skill involves selecting the appropriate drawing, table, or graph from among several choices presented.

   a. The problem statement will include a question calling for a solution, even though the problem need not be solved.

   b. For a drawing, the problem will be a routine word problem involving addition of two to four whole numbers with a sum less than or equal to 18 or involving subtraction of two whole numbers with minuend less than or equal to 18.

   c. Problems for which a table or graph is to be selected will involve simple functions or simple frequency data which can be summarized in one or two dimensions with 20 or less cells (in the case of a table). Entries for the table or graph will be relatively small numbers and definitely less than 100.

2. To solve a problem graphically involves reading or interpreting a drawing, table, or graph.

   a. Reading involves finding and directly reading a specified number or numbers from a drawing, graph, or table. For a graph, the number to be read may be on either the vertical or horizontal axis.

   b. Interpreting involves finding and reading one or more numbers in order to answer a question relating them to each other or to a number given in the problem statement (e.g.,Who has the most x? or How many more x than y?).

   c. Interpretation problems may involve examining the entire drawing, table, or graph while reading problems usually focus on one bar or one cell.

3. Graphs should be horizontal or vertical bar graphs and pictographs.

   Bar graphs will have:

   a. whole numbers less than 100,
   b. all individual intervals and bars labeled,
   c. the bottom line representing zero,
   d. all bars ending exactly <u>at</u> an interval mark, not in-between.

   Pictographs will have

   a. units of 1 only and totals less than 10,
   b. no partial units.

   Tables will:

   a. be one or two dimensions,
   b. contain a maximum of 20 cells,
   c. possibly include totals for rows and columns; if included they are counted as cells,
   d. have numbers less than 100.

SUGGESTED NUMBER OF ITEMS

drawing	1 or 2			
bar graph	1 or 2		represent	2
pictograph	1 or 2	and	solve	4
table	2			

QUESTION FORM

1. Each representation item will have a problem statement preceded by a question similar to the following:

   Which drawing (graph, table) best describes the problem?

2. The routine problems for drawings and graphs will represent the various forms of addition and subtraction (e.g. joining, comparative - see Competency 3.6).

3. The problems for tables will represent situations for which no algorithm has been taught or is available to students at Grade 3.

4. Graphs and tables will be titled and both axes/dimensions will be clearly labeled. All intervals on bar graphs will be labeled.

5. Each item will have a separate graph or table; however, the same graph or table may be used in more than one item.

6. Units of measure may be used; abbreviations and symbols (except for degree) will not be used.

RESPONSE FORM

1. A variety of representations will be used for drawing items; e.g., "actual" figures, abstract shapes, X's, tallies. However, only one type of representation will be used for all responses to a given item. Drawings may or may not be labeled with the numbers from the problem.

2. The actual answer to the problem, if solved, will not be used as a distractor; the answer may be an incidental part of a drawing or table.

3. Distractors for reading problems will include values determined by using the wrong bar, interval, cell, row, etc.

4. Distractors for interpretation problems will include values determined by insufficient examination of the graph or table, i.e., using only one dimension of the table, reading only some of the bar values.

5. If units of measure are used, distractors will not include incorrect units.

6. Distractors for graphs will be clearly wrong; that is, they will not be dependent on the student's visual acuity.

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.6

The student will be able to use addition and subtraction to solve problems in applied situations.

BRIEF DESCRIPTION

The student is expected to be able to analyze one-step verbal arithmetic problems, decide whether to add or subtract in order to solve, and then carry out that arithmetic computation to determine an answer.

SAMPLE ITEMS

1. There are 84 people at a game. 63 people are cheering for the Bears. The rest of the people are cheering for the Lions. How many people are cheering for the Lions?

   A 147
   B 27
   *C 21
   D 19

2. A poster costs 59¢. Sal has 32¢. How much more money does Sal need to buy the poster?

   A 91¢
   B 59¢
   C 36¢
   *D 27¢

3. Pat had 12 trading cards. His friend gave him 31 more. How many cards does he have now ?

   A 12
   B 19
   C 21
   *D 43

CONTENT

1. Addition problems will be restricted to 2 two-digit numbers and sums less than 100.
2. Addition problems may or may not include regrouping.
3. Subtraction problems will be restricted to 2 numbers that have one or two digits.
4. Subtraction problems will not include regrouping.
5. All problems will be one step; i.e., only one operation will be required.
6. Problems will not contain unnecessary information.

SUGGESTED NUMBER OF ITEMS

addition	2
subtraction	4

QUESTION FORM

1. Addition problems will include both joining (active) and part-part-whole (static) situations.

2. Subtraction problems will be drawn from the following types of situations:

   a. Subtractive (active)

      i. Find remainder (e.g., I had 18 marbles and gave away 6. How many do I have left?)
      ii. Find subtrahend (e.g., I had 23 marbles but gave some away. Now I have 11 left. How many did I give away?)
      iii. Find minuend (e.g., I had some marbles and gave away 7. Now I have 11 left. How many marbles did I have to start with?)

   b. Comparative (static)

      e.g., Tom has 13 marbles and Eliz has 8. How many more marbles does Tom have than Eliz?

   c. Additive (active)

      e.g., I had 10 marbles. My friend gave me some more. Now I have 19. How many marbles did my friend give me?

   d. Part-Part-Whole (static)

      e.g., Tom has 26 marbles. 15 of them are green and the rest are red. How many red marbles does Tom have?

3. Measurement contexts, especially that of money, will be used in some items. The same units must be used with each number in an item so that measurement remains incidental to the problem and no conversions are necessary. Abbreviations and symbols will not be used.

RESPONSE FORM

1. Distractors will usually include the result(s) of using the wrong operation; i.e. using addition when subtraction is appropriate and vice versa.

2. Distractors will include the result(s) of computational errors.

3. If units of measure are involved, only the unit(s) used in the problem(s) will be included in the distractors.

4. It is not necessary to label the responses (e.g., 4 dogs, 3 inches).

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.7

The student will be able to identify wanted, given, and needed information in a problem statement.

BRIEF DESCRIPTION

The student is expected to be able to read a nonroutine, two-step verbal problem (in the sense that not enough information is given to determine a solution) and analyze that problem (but not solve it) in terms of one of these three questions:

1. What question is being asked?

2. What information is already given in the problem?

3. What information is not given but is needed in order to solve the problem?

SAMPLE ITEMS

(Given Information)

1. Read the ticket problem at the right. The problem tells you something. What is it?

Ann, Kate and Bill sold tickets. Ann sold 12. Kate sold 14. Who sold the most tickets?

A Kate sold 12 tickets.
B Ann sold more tickets than Bill.
C Bill sold the most tickets.
***D** Kate sold more tickets than Ann.

(Needed Information)

2. Read the pizza problem at the right. What else do you need to know to find the answer?

A pizza was cut in pieces. Four children each ate two pieces. Was there any pizza left?

A How many children ate pizza.
B How many pieces each child ate.
***C** How many pieces the pizza was cut into.
D How much the pizza cost.

CONTENT

1. The skill involved is analyzing a problem statement to determine:

   a. what question is being asked,
   b. what information is given,
   c. what information is not given but is necessary in order to solve the problem.

2. The problem statement will include a question asking for a solution, even though the problem will not have to be solved.

3. Problems involving addition and/or subtraction will include addition of two to four whole numbers less than 100 and/or subtraction of two whole numbers less than 100 (money amounts may exceed 100¢). They may involve one operation which may be repeated, i.e., repeated addition, or more than one operation, i.e., addition and subtraction.

4. Problems, though not solved, will not be above Grade 3 difficulty level. However, they will usually be more complex than the routine problems in Competency 3.6.

SUGGESTED NUMBER OF ITEMS

wanted information	2
given information	2
needed information	2

QUESTION FORM

1. Each item will be a word problem preceded by one of the following questions (or paraphrased questions):

   a. What does the problem ask you to find?
   b. The problem tells you something. What is it?
   c. What else do you need to know to find the answer?

2. Problem statements may have extra or missing information even though the purpose of the particular item may not be an identification of extra or missing information.

3. Pictures may be used as part of the problem statement, e.g., menu prices, sales tags, etc.

RESPONSE FORM

1. Distractors will include correct information from the problem statement which is not relevant to the question asked about the particular item.

2. Information incorrectly derived from the problem statement may be used in distractors.

3. The actual answer for the problem, if solved, will not be used as a distractor or as any part of a distractor.

4. Distractors will not include any intermediate steps that might be required to determine final solution.

SUBJECT: **Mathematics**
GRADE LEVEL: **3**

COMPETENCY 3.8

The student will be able to read instruments for measuring length, time, temperature, capacity, and weight.

BRIEF DESCRIPTION

The student is expected to be able to read a measurement from a simple measuring device that is marked with an easily readable numerical scale. Such devices are a ruler, a clock (regular or digital), a thermometer, a measuring cup, and a weight scale (kitchen or bathroom).

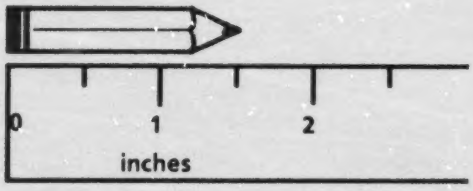
SAMPLE ITEMS

1. What time is shown on the clock?

A 6:30
B 6:10
*C 2:30
D 2:15

2. How many inches long is the pencil?

A $\frac{1}{2}$
B 1
*C $1\frac{1}{2}$
D 2



3. What is the temperature shown on the thermometer?

A 5°C
*B 7°C
C 10°C
D 12°C

CONTENT

1. Instruments will include a ruler (metric or nonmetric), clock (regular or digital), thermometer (°C or °F), measuring cup, and common weight/mass scale (bathroom or kitchen). The unit markings on the measuring instruments may be both numbered and unnumbered, but only one unnumbered mark will appear between any two numbered marks (except for thermometers).

29

2. Reading of the measuring instruments will involve only the measurement of quantities that end at a mark shown on the instrument and not between marks.

3. Vocabulary words in addition to the units of measure include: thermometer, temperature, scale, pointer, time, o'clock.

SUGGESTED NUMBER OF ITEMS

length	1
time	2
temperature	1
capacity	1
weight	1

QUESTION FORM

1. All items will include a drawing of a measuring instrument (usually in the stem, but occasionally in the responses).

2. The unit of measure will be clearly indicated on all drawings.

3. Abbreviations and symbols will not be used for the labels or in the text with the exception of temperature (e.g., 25° F).

4. Each instrument will have at least three numbered units, with the exception of the measuring cup.

5. Rulers will be marked and numbered at each inch or centimeter interval. Unnumbered marks will appear for each intermediate half-inch or half- centimeter interval.

6. Thermometers will be marked and numbered at each 5° interval. The numbers may be all on the same side or on alternate sides. Unnumbered marks will appear for each intermediate 1° interval.

7. Measuring cups will be marked and numbered at each 1/4-cup interval if total capacity is one cup, and at each 1/2-cup interval if total capacity is more than one cup. Intermediate unnumbered marks will not be used.

8. Weight/mass scales will be marked and numbered at ten-pound, one-pound, or one-ounce intervals. Unnumbered marks will appear at each intermediate five-pound, half-pound, or half-ounce interval, respectively.

9. Items involving rulers will require that measurements be made from the zero end. In other words, students will not be required to measure 3 cm by going from the 2 cm mark to the 5 cm mark.

10. On clocks, the hour and minute hands will be clearly different in length. Second hands will not be included.

11. Clock items may involve reading time expressed in either of two forms, e.g., 2:00 or 2 o'clock. Accuracy will be to the nearest quarter hour.

12. For length, weight, and liquid capacity items, the stem will state the unit being measured (e.g., How many centimeters long is the key?).

RESPONSE FORM

1. All responses will be in the same units of measure.

2. Distractors will include the results of measures made by choosing numbered marks or by assigning numbers to unnumbered marks. They will generally not involve points on an instrument other than those marked.

3. In most cases responses will not have to be labeled, since each will be in the unit of measure stated in the stem. An exception is temperatures, since the units (e.g., degrees Celsius) are not stated in the stem.

4. Abbreviations and symbols will not be used (except for °C, °F).

SUBJECT: Mathematics
GRADE LEVEL: 3

COMPETENCY 3.9

The student will be able to identify appropriate units for measuring length and time.

BRIEF DESCRIPTION

The student is expected to be able to tell what unit is a proper one to measure either length or time. Two aspects are important. First, size of units goes with size of things to be measured; one does not measure length of a person's finger with miles, for example. Second, units must be of the same type as the thing being measured; one measures the length of a person's finger with inches or centimeters and not with pounds or minutes, for example.

SAMPLE ITEMS

1. The length of a paper clip is about 1 _____.

   A foot
   B yard
   *C inch
   D mile

2. What unit would you use to tell someone how far you ran?

   A pint
   B year
   C pound
   *D yard

3. Many men have a height of about 6 _____.

   A miles
   B meters
   C centimeters
   *D feet

CONTENT

1. Units will include:

   a. length (nonmetric) - inches, feet, yards;
   b. length (metric) - centimeters, meters;
   c. time - minutes, hours.

2. The appropriateness of a unit of measure involves two dimensions.

   a. When all units under consideration measure the same attribute (e.g., length), appropriateness is based upon the size of the unit relative to the size of the entity being measured (e.g., one does not measure the length of a pencil using miles as a unit).

b. When all units under consideration measure <u>different</u> attributes (e.g., length, duration, weight, capacity), appropriateness is based upon whether the unit has the same attribute as the entity being measured (e.g., one does not measure the length of a pencil using pounds as a unit).

3. Vocabulary words may include, in addition to the units of measure above: unit, length, height, width.

4. Numbers, if used, will be whole numbers less than 100.

SUGGESTED NUMBER OF ITEMS

	choose unit from same attribute	among units having different attributes
length	2	2
time	1	1

QUESTION FORM

1. There will be no determination of the measurement itself, only identification of the unit. If a numerical quantity is necessary, it will be included in the stem so that it applies to <u>all</u> responses (e.g., Jim walked for 5 _____).

2. The content to be measured may be represented verbally only (e.g., What unit tells how long a TV show is?). Pictures will not be used.

3. Abbreviations and symbols for units of measure will not be used.

RESPONSE FORM

1. Distractors for a single item may include units from both the metric and nonmetric systems.

2. Care will be taken to assure that not more than one unit is conceivably appropriate.

3. Units other than those specified in the content domain may be included in the distractors, e.g., days, weeks, years, miles, pounds, pints, or other units which are familiar.

4. Abbreviations and symbols for units of measure will not be used.

SUBJECT: **Mathematics**
Grade Level: **3**

COMPETENCY 3.10

The student will be able to recognize equivalent measures and use them to add and subtract measures of length, time, and money.

BRIEF DESCRIPTION

The student is expected to be able to make simple conversions, such as, two weeks equals 14 days or 3 quarters are 75 cents. Also, the student should be able to use this converting ability within the context of verbal problems dealing with money and making change.

SAMPLE ITEMS

1. Tom cut a string 2 meters long. How many centimeters long is the string?

   A 2
   B 20
   C 100
   *D 200

2. Jill took 3 quarters and 1 nickel to the store. She spent 45¢. How much money did Jill have left?

   A 10¢
   B 30¢
   *C 35¢
   D 41¢

3. The Jackson family vacation lasted 3 weeks. How many days was that?

   A 7
   *B 21
   C 30
   D 31

CONTENT

1. Conversions will be made without the provision of a table of equivalents.

2. Conversions will involve more than statement of a simple equivalence that could be found in a table. For example, not 1 week = 7 days, but 2 weeks = 14 days, or 3 weeks = 21 days.

3. Conversions will be restricted to those that require multiplication by a one-digit number. This implies that conversions will go from a larger entity to a smaller entity. Those that may be included are:

   a. Length: feet to inches; yards to feet; meters to centimeters
   b. Time: hours to minutes; weeks to days; years to months
   c. Monetary value: quarters to cents; dimes to cents; nickels to cents.

   The only exception will be a conversion involving division in the metric system, where the significant digits do not change when smaller units are converted to larger units. For example, 400 cm = 4 meters.

4. Length conversions between metric units and nonmetric units will not be included.

5. Number size will be restricted to two-digit whole numbers or simple multiples of 100. (Exception: distractors for money items may include three-digit numbers expressed as dollar and cents.)

6. The problems will be simple and of two types:

   a. word problems involving only conversion of one or more amounts;
   b. word problems involving conversion(s) of one or more amounts, plus a further simple routine problem question (e.g., how many are left? See Competency 3.6.)

7. The problems will require one or two operations, i.e., addition or subtraction or both. No more than three repeated additions will be required (this is considered one operation, though repeated).

SUGGESTED NUMBER OF ITEMS

	conversion only	conversion and problem
length (nonmetric)	1	0
length (metric)	1	0
time	1	0
money	1	2

QUESTION FORM

1. Pictures may be used for items involving the value of a group of coins.

2. Abbreviations and symbols for measurements will not be used (except for dollars and cents).

3. The unit desired for the correct response will be clearly indicated (except for money items, in which it is usually implied).

RESPONSE FORM

1. Responses will be restricted to a single unit (e.g., 15 inches, not 1 foot 3 inches).

2. Distractors will include the results of:

   a. making no conversion (e.g., simply operating on the given numbers),
   b. incorrect conversions (e.g., 1 foot = 100 inches),
   c. making one but not all conversions required,
   d. doing only the conversion (and not the second operation) for items which involve conversion plus another question to answer.

3. Except for money problems, responses will not be labeled with a unit, since it is assumed all responses are in the unit of measure specified in the stem.

4. Abbreviations and symbols (except for dollars and cents) will not be used.

GRADE 7
MATHEMATICS ITEM SPECIFICATIONS

GENERAL ITEM SPECIFICATIONS

1. Readability will be below Grade 7 level.

2. Problem content, particularly that of word problems, will be of interest to and relevant for Grade 7 students.

3. Although scratch paper will be available, when possible, sufficient space in the test booklet to work directly on items will be provided.

4. Occasionally, characteristics of the question will also apply to the responses and vice versa; for example, restrictions for labeling geometric figures generally apply whether the figure is part of the question or a response.

5. Each competency will be measured by six test items.

SUBJECT: Mathematics
GRADE LEVEL: 7

COMPETENCY 7.1

The student will be able to recognize equivalent representations of whole numbers and decimals expressed in words, in conventional notation, in expanded notation, or in exponential notation.

BRIEF DESCRIPTION

The student is expected to be able to convert whole numbers or decimals written in one symbolic form into another symbolic form. These forms are words, standard place-value notation, or expanded notation. The student is also expected to know the meaning of exponential notation when the exponent is either 2 or 3 and the base is a whole number.

SAMPLE ITEMS

1. Three million, two hundred thousand, five is ___.

   A 300,200,005
   B 30,205,000
   C 3,020,005
   *D 3,200,005

2. In expanded notation, 23.803 is _____.

   A 2 + 3 + .8 + .3
   B 20 + 3 + .8 + .03
   *C 20 + 3 + .8 + .003
   D 20 + 3 + .08 + .3

3. 5^3 = _____

   A 5 + 5 + 5
   B 5 x 3
   C 3 x 3 x 3 x 3 x 3
   *D 5 x 5 x 5

CONTENT

1. The place values of the numbers will range from thousandths to millions, with a maximum of 7 places in a single item.

2. Conversions will be from conventional notation to expanded notation or to words, and vice versa.

3. For whole numbers, the following forms of expanded notation will be used:

   a. 1,502 = 1 x 1,000 + 5 x 100 + 2 x 1
   b. 1,502 = 1,000 + 500 + 2
   c. 1,502 = 1 thousand + 5 hundreds + 2 ones

4. For decimals, the following forms of expanded notation will be used:

   a. $8.75 = 8 \times 1 + 7 \times 1/10 + 5 \times 1/100$
   b. $8.75 = 8 + .7 + .05$
   c. 8.75 = 8 ones + 7 tenths + 5 hundredths

5. Exponents will be used with whole numbers only and are restricted to squares and cubes.

6. Numbers raised to a power will be less than 10.

SUGGESTED NUMBER OF ITEMS

whole numbers			
conventional notation	↔	words	1
conventional notation	↔	expanded notation	1
exponential notation			1
decimals (total of 3 items)			
conventional notation	↔	words	1 or 2
conventional notation	↔	expanded notation	1 or 2

QUESTION FORM

1. Forms of numbers created by regrouping will <u>not</u> be used; e.g., 431 = 43 tens + 1 one.

2. Exponential notation will <u>not</u> be used as part of expanded notation; e.g., $335.2 = 3 \times 10^2 + 3 \times 10^1 + 5 \times 10^0 + 2 \times 10^{-1}$.

3. Parentheses will <u>not</u> be used; e.g., 432 = 4(100) + 3(10) + 2(1).

4. Some items will include zeroes.

5. Unnecessarily tricky word conversions will <u>not</u> be used; e.g., three hundred and three hundredths = 300.03.

RESPONSE FORM

1. All stem characteristics above and response characteristics below will be applied as appropriate when items have stem and response reversed.

2. The correct response and all distractors will be in the same form of expanded notation for a single item.

3. Distractors for expanded notation (or conventional notation when applicable) will include missing, excess, or misplaced decimal points, commas, or digits (especially zeroes), and also misnamed places.

4. Distractors for word representations (or conventional notation when applicable) will include missing, excess, or misplaced commas. The misuse of the word "and" will be incorporated in some distractors. Misnamed places will be included, e.g., 101.1 = ten thousand, eleven.

5. Commas will be used correctly even when numbers are wrong; i.e., 3,12,022 <u>or</u> 3,0002, etc., will not be used.

6. Distractors for both expanded notation and word representations will <u>not</u> reorder place values. For example, expressions such as $252 = 2 \times 10 + 5 \times 100 + 2 \times 1$, or 300.49 = three hundredths and forty-nine hundreds will not be used.

7. Distractors for exponentiation items will include common misconceptions, such as $a^b = a \times b$, $a + b$, $b \times b \times \cdots \times b$ (a times), $a + a + \cdots + a$ (b times).

SUBJECT: Mathematics
GRADE LEVEL: 7

COMPETENCY 7.2

The student will be able to add, subtract, multiply, and divide whole numbers and decimals.

BRIEF DESCRIPTION

The student is expected to be able to use familiar computational algorithms for the four fundamental arithmetic operations--addition, subtraction, multiplication, and division (one-digit divisor only)--with whole numbers and decimals.

SAMPLE ITEMS

1. $4.207 \div .7 =$ __

   A .61
   *B 6.01
   C 6.1
   D 60.1

2. $38 + 74 + 67 =$ _____

   A 169
   B 178
   *C 179
   D 189

3. $370 \times 60 =$ _____

   A 2,220
   B 4,220
   *C 22,200
   D 42,200

CONTENT

1. Number size will be limited by the restrictions below; however, solutions may necessarily exceed these maximums.

   Whole numbers:

   Addition:
   a. not more than 4 two-digit addends,
   b. not more than 2 three-digit addends,
   c. not more than 3 significant digits in 1 addend; e.g., 2 five-digit addends with 3 significant digits each are permissible.

   Subtraction:
   a. not more than 3 significant digits in the minuend or subtrahend.

Multiplication:
a. not more than a total of 4 significant digits in 2 factors.

Division:
a. not more than 4 significant digits in the dividend,
b. not more than 1 significant digit in the divisor.

Decimals:
The restrictions for operations with whole numbers apply; they refer to the total number of digits to the left and right of the decimal point. For example, 26.3 - .389 = __ and 2600 - 3.89 = __ are permissible, but 26.38 - .389 and 2.638 - .3891 are not.

2. All addition and subtraction problems will require regrouping.

3. Subtraction problems will not have negative solutions.

4. Division problems will not have remainders.

5. Only one operation (addition, subtraction, multiplication, or division) will be required in each problem; addition may be repeated.

SUGGESTED NUMBER OF ITEMS

whole numbers	3
decimals	3

All four basic operations (+ , − , x, ÷) must be represented.

QUESTION FORM

1. Problems will be presented in a horizontal format.

2. Some items will include numbers with two different numbers of digits; e.g., 281 + 45 = __ .3 x .574 = __.

3. Some items will have interior zeroes.

4. Some decimal items will require aligning decimals with unlike positions and numbers of digits.

5. Decimals of the form 36.0 or 2.0 will not be used.

RESPONSE FORM

1. Distractors will include the result of common computational errors such as failure to regroup, improper regrouping, reversal of divisor and dividend, and improper alignment or placement of decimal points.

2. Most distractors will be the results of incorrect uses of algorithms rather than of errors in basic facts.

SUBJECT: Mathematics
GRADE LEVEL: 7

COMPETENCY 7.3

The student will be able to determine solutions for number sentences including equalities and formulas.

BRIEF DESCRIPTION

The student is expected to be able to evaluate a formula by substituting in whole-number values for the letters contained in the formula, and to be able to solve a linear equation that requires, at most, 2 solution steps.

SAMPLE ITEMS

1. If L = 5 and W = 4, what is the value of p in the formula p = 2L + 2W?

   A 14
   *B 18
   C 40
   D 80

2. In the equation, 2 x n = 56, n = _____

   A 112
   B 102
   C 54
   *D 28

3. Solve the equation, 3 x a - 8 = 25

   *A 11
   B 14
   C 30
   D 51

CONTENT

1. The skills included are:

   a. evaluating a formula for an unknown which stands alone on one side of an equal sign,

   b. checking an equation to see which value is a solution,

   c. solving a given equation that involves, at most, 2 solution steps.

2. Formulas will be restricted to 3 or fewer variables and/or terms, including the variable to be solved for.

3. Constants and replacement values for variables in formulas will be one-digit positive integers or positive multiples of 10.

4. Equations to be checked will be restricted to no more than 2 terms on one side of the equal sign and one on the other side.

5. No negatives will be included.

SUGGESTED NUMBER OF ITEMS

evaluate formulas	2
check/solve equations	4

QUESTION FORM

1. Any alphabet letter, upper or lower case, may be used as a variable name. Preference is given to forms children are familiar with in their instructional programs.

2. Some formulas will include parentheses.

3. The variables in equations will only appear on the left side of the equal sign.

4. Directions for equation will be in one of these forms:

   In the equation $n + 7 = 21$, $n =$ _____ or Solve the equation $n + 7 = 21$.

RESPONSE FORM

1. Distractors for formula problems will include:

   a. the results of substitution errors,
   b. the results of incorrectly evaluating (solving) equations after correct substitutions have been made.

2. Distractors for formula problems will emphasize operational rather than computational errors.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.4

The student will be able to identify common geometric figures and relationships.

BRIEF DESCRIPTION

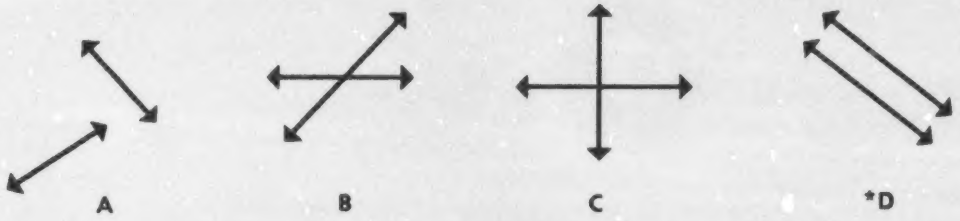
The student is expected to be able to recognize the shapes and names associated with familiar two- and three-dimensional geometric figures such as circles, squares, rectangles, triangles, cones, cylinders, rectangular prisms, etc. The student is also expected to be familiar with certain relationships and names describing them, such as parallel, perpendicular, and congruent.

SAMPLE ITEMS

1. Identify the figure.

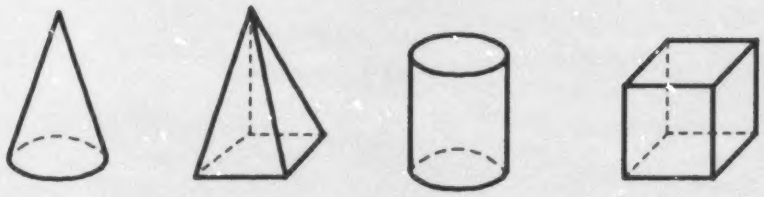
A triangle
*B quadrilateral
C rectangle
D parallelogram

2. Which lines are parallel to each other?



A B C *D

3. Which figure is a pyramid?



A *B C D

CONTENT

1. Two-dimensional figures may be right angles, circles, triangles, squares, parallelograms, or rectangles.

2. Three-dimensional figures may be rectangular prisms, pyramids, spheres, cylinders, or cones.

3. Relationships may involve right vs. other angles; intersecting, parallel, or perpendicular lines or planes; congruent segments, angles, or triangles.

4. Identification of relationships will be based on informal inspection of the figures rather than on knowledge of formal rules.

SUGGESTED NUMBER OF ITEMS (6 items total)

2-dimensional figures	1 or 2
3-dimensional figures	1 or 2
relationships	3

QUESTION FORM

1. Figures will always be used (if not in the stem, then in responses).

2. Some problems will require naming a given figure or figures, while others require identifying a figure from its name.

3. Figures will be about the same size within a particular problem.

4. Figures will be placed in various orientations.

5. No letter labels, units or markings will appear on figures. (Exception: identification of particular types of triangles, such as isosceles vs. scalene, may require units to appear.)

6. Lines will always be presented as continuous; segments (and rays) will not be included in the stem.

RESPONSE FORM

1. Distractors may include other figures, such as ellipses, irregular polygons, rays.

2. The characteristics for the stem apply when figures are used in the responses.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.5

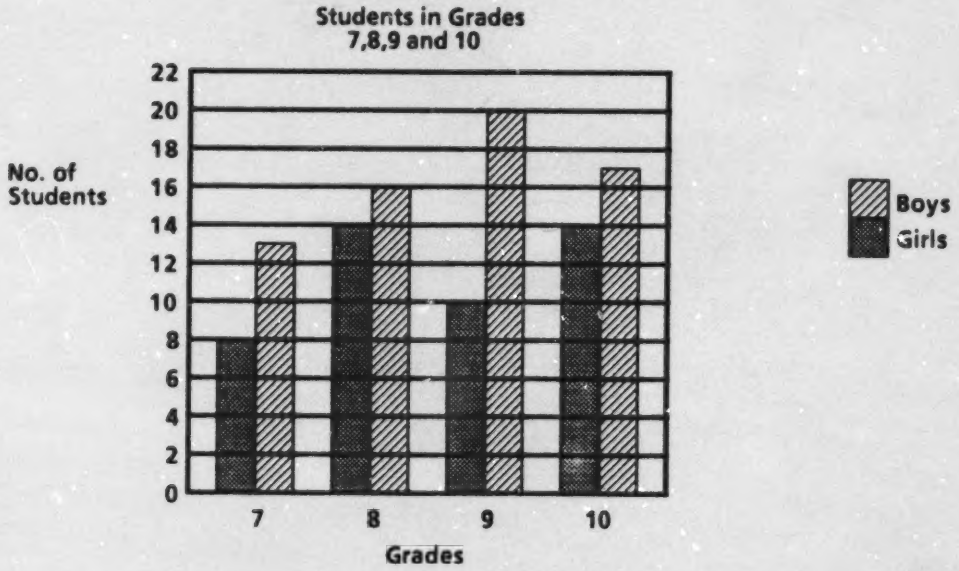
The student will be able to read and interpret tables and graphs.

BRIEF DESCRIPTION

The student is expected to be able to extract one or more pieces of data from bar graphs, circle graphs, line graphs, pictographs and tables, and to be able to relate those data to each other or to other information or to questions contained in a problem.

SAMPLE ITEMS

1. How many more boys than girls are there in Grade 9?



A 4
B 6
*C 10
D 20

2. Which age group was the largest in 1980?

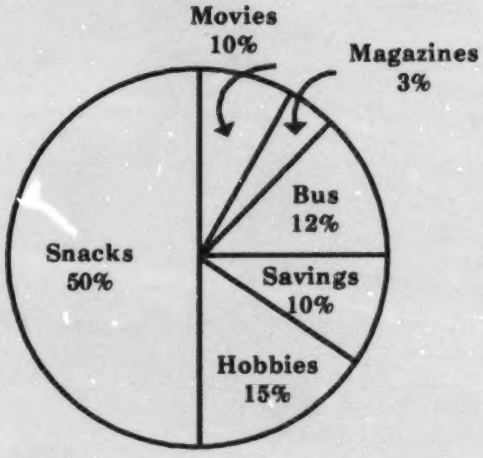
Wisconsin Population by Age

Age	1970	1980
Under 5	382,000	347,000
5-14	935,000	737,000
15-24	770,000	917,000
25-34	506,000	750,000
35-44	470,000	502,000
45-54	476,000	453,000
55-64	404,000	436,000
65-74	284,000	330,000
75-84	151,000	178,000
85 and over	38,000	56,000

A 85 and over
B 25-34
*C 15-24
D 5-14

3. What does Roberto spend the most money on each month?

ROBERTO'S MONTHLY BUDGET



A movies
*B bus
C magazines
D snacks

CONTENT

1. a. Reading involves finding and reading a specified number or numbers in a graph or table. For a graph, the number to be read may be on either the horizontal or vertical axis.
   b. Interpreting involves finding and reading one or more numbers in order to answer a question relating them to each other or to a number given in a problem statement. (Who has the most x? How many more x than y?)

   Interpretation problems may involve examining an entire graph or table, while reading problems will usually focus on one bar, one cell, or one point on a line.

2. Within the broad definition of reading and interpreting is also included the skill of choosing from among several tables or graphs the one that best describes a given set of data.

3. Graphs will be horizontal and vertical bar graphs with single or double bars, pictographs, circle graphs, or line graphs with one or two lines.

   Bar and line graphs will have:

   a. whole numbers with no more than 3 significant digits;
   b. all marked intervals labeled;
   c. the horizontal axis not always representing zero;
   d. bars ending both at and in between intervals; lines (points) both at and in between intervals;
   e. a key for double bars or two lines.

   Pictographs will have:

   a. units which are multiples of 5 or 10 with no more than 2 significant digits; totals will be whole numbers less than 1,000,000;
   b. some partial units--halves or fourths;
   c. a key.

   Circle graphs will have:

   a. whole percents,
   b. 5 or more divisions.

3. Tables will:

   a. be two dimensional (except for single-frequency tables),
   b. contain a maximum of 40 cells,
   c. include totals when relevant,
   d. have whole numbers with no more than 3 significant digits.

4. Line graphs and table problems will not require interpolation or extrapolation; although such values may be potentially derivable, no questions will require it. However, graph problems may require estimating values for a bar or point which do not fall exactly at an interval mark. This is not interpolation because the value for one axis is exact.

SUGGESTED NUMBER OF ITEMS

graphs (to include)	4			
bar,	1		read	2
pictograph,	1	and	interpret	4
circle,	1			
line	1			
tables	2			

QUESTION FORM

1. Graphs and tables will contain information of interest to or relevance for Grade 7 students.

2. Graphs and tables will be titled and both axes/dimensions will be clearly labeled. All intervals on graphs will be labeled.

3. Each problem will have a separate graph or table; however, the same graph or table may be used in more than one item.

4. Units of measure, abbreviations, and symbols may be used.

RESPONSE FORM

1. Distractors for reading problems will include values determined by using the wrong bar, point, cell, row, interval, etc., or by not correctly using the key in pictograph items.

2. Distractors for interpretation problems will include values determined by insufficient examination of the graph or table, i.e., using only one dimension of the table, reading only some of the points. They may also include calculation errors.

3. If units of measure are used, distractors will not include incorrect units.

4. Distractors for graphs will be clearly wrong; that is, they will not depend on the student's visual acuity.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.6

The student will be able to use addition, subtraction, multiplication, and division to solve problems in applied situations.

BRIEF DESCRIPTION

The student is expected to be able to analyze one- or two-step verbal arithmetic problems (including percent, simple proportion problems), decide which operations (+ , -, x, ÷) to use in order to solve them, and then carry out those operation(s) to determine answers.

SAMPLE ITEMS

1. There are 75 students in the symphony. Fifteen students are also in the band. What percent of the students in the symphony are also in the band?

   A 25%
   *B 20%
   C 15%
   D 5%

2. The school needs 30 brushes for each of its 6 art classes. If the brushes come in packages of 9, how many packages should be ordered?

   A 270
   B 180
   C 54
   *D 20

3. If a car travels 105 km in 3 hours, how far will it go in 7 hours traveling at the same rate of speed?

   A 45 km
   *B 245 km
   C 525 km
   D 2,205 km

CONTENT

1. Problems will be routine word problems involving:

   a. the uses of percent,
   b. measurement contexts,
   c. two different operations or a repeated operation,
   d. simple ratio and proportion.

   There will be problems that combine two of these attributes.

2. The three forms of percent problems will be included:

   a. Find a percent of a number;
   b. Find what percent one number is of another number;
   c. Find a number given a percent of that number.

3. Measurement problems will not include conversions from one unit to another. (Exception: money items in which cents must be converted to dollars.)

4. Numbers will be restricted according to the rules for operations with whole numbers, decimals, fractions, and mixed numbers given in Competencies 7.2 and 7.11.

5. Percents will be whole numbers less than 100.

6. Proportion problems will have a solution of form $n = \frac{a \times b}{c}$ where c is a divisor of a and/or b.

SUGGESTED NUMBER OF ITEMS

percent	2	
measurement	2 or 3	NOTE: These categories overlap - e.g., a percent problem may be posed in a measurement context.
two (or repeated) operations [non-proportion]	2	
ratio/proportion	1	

QUESTION FORM

1. Numbers will be selected carefully so that arithmetic proficiency cannot be a source of error. They will be as simple as possible and yet be realistic. Thus, unless absolutely needed for the context, fractions will not be used. Calculations will be made convenient by use of some numbers which are multiples of 10, numbers which do not result in remainder or continuing decimals, etc.

2. Percent problems in Form C, listed above (find a number given a percent of that number), will not be artificial; that is, it should be likely that the numbers in question in these problems will not be known.

RESPONSE FORM

1. Distractors will be the results of applying incorrect operations, or, of completing only one operation when two (or repeated operations) were required, or of applying correct operations to the wrong number(s).

2. Distractors which are the result of computational errors may be used, but should be de-emphasized.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.7

The student will be able to solve problems that can be solved by procedures such as looking for a pattern, constructing a table, using guess and check procedures, or using a drawing.

BRIEF DESCRIPTION

The student is expected to be able to solve nonroutine problems by using a variety or combination of nonalgorithmic procedures. Nonroutine problems are not "tricky" problems, but can be described as being not of the standard "application" story problem types that often appear as exercises in textbooks following instruction in some computational skill.

SAMPLE ITEMS

1. Ken's parents gave him $3.00 spending money for each day of a 2-week vacation. The vacation started on a Monday. By the end of the day on Wednesday of the first week, Ken had spent $15.00. If he continued to spend at that rate, on which day would he run out of money?

   A on Saturday of the first week
   B on Monday of the second week
   *C on Tuesday of the second week
   D on Sunday of the second week

2. Seven boys are standing in a circle. No two boys who are standing beside each other have on the same color shirt. What is the smallest number of different shirt colors the boys could be wearing?

   A 2
   *B 3
   C 4
   D 7

3. A store only has red marbles for 5¢ and white marbles for 2¢. A child bought 4 marbles for 11¢. How many white marbles did the child buy?

   A 4
   *B 3
   C 2
   D 1

CONTENT

1. Problems will require the student to use more than immediate recall or previously established routine solution procedures or algorithms. In contrast, a routine problem is one for which the student has been taught a method of solution, so he/she knows immediately or with little effort how to proceed to find the solution.

2. Problems will be limited to those that are most likely to be solved by the application of one or more of the following problem-solving strategies:

   a. using guess and check procedures,
   b. looking for a pattern,
   c. constructing a table,
   d. using a drawing.

   It must be recognized that these strategies are not mutually exclusive. It should also be emphasized that a student does not have to use one of these four strategies.

3. Problems will be posed in such a way as to get at the student's ability to recognize <u>when</u> to use a particular method or methods to solve a problem.

4. Numbers will be whole numbers less than 100. Fractions will be avoided unless absolutely necessary.

5. Little, if any, calculation will be required.

6. Problems will not include extraneous information.

7. Problems will not extend more than 2 steps.

SUGGESTED NUMBER OF ITEMS

guess and check	3
looking for pattern	1
constructing a table	1
using a drawing	1

This distribution of item types is merely suggested, because of the highly idiosyncratic nature of human problem solving.

QUESTION FORM

1. There will be a problem statement which includes data, a drawing, or a description of a situation.

2. A question will be asked.

3. Solving the problem will not require the manipulation of large amounts of data (i.e., 25 total entries) and the problem will have no more than 3 variables or 3 given conditions.

RESPONSE FORM

1. Distractors will be based on incorrect manipulations of information in the problem.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.8

The student will be able to determine the length, area, volume, and angle measure of common geometric figures.

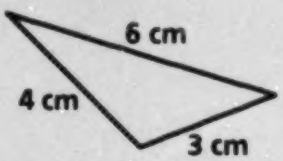
BRIEF DESCRIPTION

The student is expected to be able to use common geometric formulas and/or knowledge to determine perimeter, area, and volume of simple figures. Dimensions of figures, or parts of figures, that are to be used will be given in the problems and will consist of whole numbers. To determine angle measure, the student is expected to be able to read a protractor.

SAMPLE ITEMS

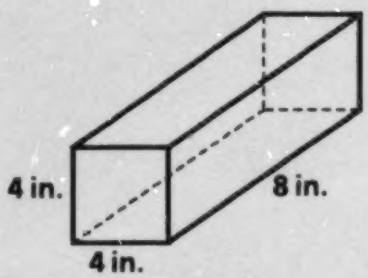
1. What is the perimeter of the triangle?

   A 5 cm
   B 8 cm
   *C 13 cm
   D 16 cm



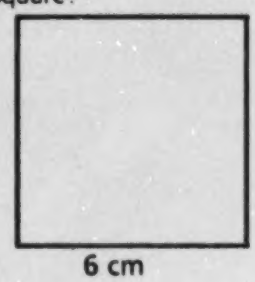
2. What is the volume of the box shown?

   A 16 in^3
   B 24 in^3
   C 32 in^3
   *D 128 in^3



3. What is the area of the square?

   A 12 cm^2
   B 24 cm^2
   *C 36 cm^2
   D 48 cm^2



CONTENT

1. Geometric attributes and figures covered are:

   a. perimeters of polygons of up to six sides; knowledge of the definition of regular polygons will not be assumed;

   b. areas of rectangles, squares, and triangles;

   c. volumes of cubes, rectangular prisms;

   d. angle measure with rays superimposed on a protractor.

2. Knowledge of all formulas associated with the above attributes will be assumed.

3. Problems involving the Pythagorean theorem will not be included.

4. Dimensions of figures will be one- or two-digit whole numbers.

SUGGESTED NUMBER OF ITEMS

length	2
area	2
volume	1
angle	1

QUESTION FORM

1. Drawings will be provided for all items.

2. Drawings will be clearly labeled. Abbreviations (in.) or symbols (cm) may or may not be used.

3. All dimensions will be in the same units of measurement; i.e., conversions will not be required.

RESPONSE FORM

1. Distractors will include the results of finding the wrong attributes, e.g., perimeter instead of area.
2. Distractors will include the results of errors in formulas, e.g., using $p = 2lw$.

3. All responses will be labeled with the same unit, even though some distractors may actually be numbers derived using a different unit.

SUBJECT: Mathematics
GRADE LEVEL: 7

COMPETENCY 7.9

The student will be able to round numbers and to estimate the results of addition, subtraction, multiplication, and division of whole numbers, decimals, and fractions.

BRIEF DESCRIPTION

The student is expected to be able to take a given number of up to five significant digits and to round up or down to a specified place, either to the left or right of a decimal point. The student is also expected to be able to estimate answers to computational problems by first rounding to numbers with one significant digit and then computing with basic facts and knowledge of place value.

SAMPLE ITEMS

1. Round 42.726 to the nearest tenth.

   A 40
   *B 42.7
   C 42.73
   D 42.8

2. Which is the best estimate of the answer to this problem?

   *A 160
   B 145.67
   C 140
   D 55.67

   $168.84 - 13.17 = \square$

3. Which is the best estimate of the answer to this problem?

   *A 20
   B 30
   C 200
   D 300

   $27\overline{)598}$

CONTENT

1. Rounding requires a number to be rounded up or down to a specified place. Whole numbers may be rounded to the tens, hundreds, or thousands place. Decimals may be rounded to a whole number place or to tenths or hundredths.

2. Numbers in rounding problems will include whole numbers less than 10,000 and decimals less than 10,000 with digits to the ten-thousandths place.

3. Estimation will involve the result of only one operation. (This includes the special case of addition of more than 2 addends in which only one operation is used but is repeated.)

4. Estimation with decimals, fractions, and mixed numbers will not include the operations of multiplication and division.

5. Estimation will emphasize the process of restating the problem in rounded numbers rather than getting a particular result; e.g., 79 + 47 = __ becomes 80 + 50 = __ and the correct response is 130.

6. Numbers in estimation problems will be restricted according to the operation involved (see Competencies 7.2 and 7.11). An exception is division, where a two-digit divisor (before rounding) is allowed.

SUGGESTED NUMBER OF ITEMS

rounding

whole numbers	1
decimals	1

estimating (4 items total)

whole numbers	3		addition	1
fractions, decimals, or		and	subtraction	1
mixed numbers	1		multiplication	1
			division	1

QUESTION FORM

1. Items will not require students to round 5's, as there are several different rules for this.

2. For estimation items, students will be directed to choose the best estimate of the answer (rather than calculate it).

RESPONSE FORM

1. Distractors for rounding items will be based on rounding to the wrong place, rounding to a value which is not the nearest value (even though it is the right place), or rounding up when the number should have been rounded down (or vice versa).

2. For estimation items, the correct response for decimal and mixed number problems will be a whole number; for fraction problems, it may or may not be a whole number.

3. Distractors for estimation items will be poorer estimates of the actual answer (if calculated) than the correct response is.

4. Distractors for estimation items may be numbers which appear to be "exact"; these may be partially based on the calculated answer, but must be poorer estimates than the correct response (estimate). The purpose of this type of distractor is to detect calculating (rather than estimating).

5. Answers will result from rounding to one significant digit.

6. Since the choice of rounded-to numbers in estimation problems is arbitrary in some cases, e.g., 569 + 512 = □ would become 570 + 510 or 600 + 500, care has been taken to provide only one of the reasonable alternatives as the correct response, e.g., 1080 or 1100, but not both.

7. For estimation items, the actual (calculated) answer will not be included as a distractor.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.10

The student will be able to recognize equivalent representations of rational numbers expressed as fractions, decimals, or percents.

BRIEF DESCRIPTION

The student is expected to be able to convert fractions, decimals, and percents from one form to another.

SAMPLE ITEMS

1. What is another name for 35%?

   A .035
   *B .35
   C 3.5
   D 35

2. What is another name for 3/4?

   A 25%
   B 30%
   C 34%
   *D 75%

3. What is another name for .40?

   A 1/4
   B 10/4
   C 4/100
   *D 2/5

CONTENT

1. Recognition of equivalent representations will include conversions among decimals, fractions, and percents, and conversions between equivalent fractions.

2. Denominators of fractions to be converted to decimals and vice versa will be based on terminating decimals; that is, 2, 4, 5, 8, and 10, or other denominators that have 2 and/or 5 as prime factors (20, 25, etc.).

3. Percents will be whole numbers less than 100%; special cases (e.g., 12.5%, 150%) may be included if conversions involve terminating decimals.

4. Conversions of percents to fractions (or to decimals) and vice versa will involve both reducible and nonreducible fractions; e.g., $\frac{63}{100}$ and $80\% = \frac{80}{100} = \frac{4}{5}$

5. Conversions among equivalent fractions will be based on fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 16, and their multiples.

SUGGESTED NUMBER OF ITEMS

decimal	↔	percent	1 or 2	At most, 3 items devoted to percent.
fraction	↔	percent	1 or 2	When 2 items in a category are chosen, both
decimal	↔	fraction	1 or 2	directions for conversion will be utilized.
fraction	→	fraction	1	

QUESTION FORM

1. Directions will be, for example:

   a. what is another name for 1/5?
   b. what is another name for 20%?

RESPONSE FORM

1. Only one form of equivalents will be included in the response choices for a single item; e.g., all choices should be percents, or all decimals, etc.

2. The correct responses for fractions (other than fraction equivalence items) will be in lowest terms; unreduced correct fractions are not used as distractors. However, unreduced incorrect fractions may be used.

3. Distractors may have fractions with denominators other than those specified for stems when necessary.

4. Distractors for conversions from decimals to percents (and vice versa) will involve misplacement of the decimal point.

5. For conversions from fractions to percents, distractors will include the results of dividing denominators by the numerators, making a numerator (or denominator) alone or as a multiple of 10 into the percent, or in some other erroneous way combining a numerator and denominator (e.g., 1/4 = 14%) to form a percent.

6. For conversions from percents to fractions, distractors will include improperly reduced fractions and results of using the wrong denominator (e.g., 12.5% = 125/100).

7. For conversion from fractions to decimals (and vice versa), distractors will include errors in placement of the decimal point (e.g., 8/10 = .08) or in place value <u>per se</u> (e.g., .9 = 9/100).

8. For fraction equivalences, distractors will include simple inversions, and the result of simply adding the numerator and denominator (then using the sum as numerator or denominator), or of taking different multiples of the numerator and denominator rather than multiplying by the same number.

SUBJECT: **Mathematics**
GRADE LEVEL: **7**

COMPETENCY 7.11

The student will be able to add, subtract, and multiply fractions and mixed numbers.

BRIEF DESCRIPTION

The student is expected to be able to compute with fractions and mixed numbers by using standard computational procedures. For addition and subtraction of proper fractions, unlike denominators are used. Ability to reduce answers to lowest terms is expected.

SAMPLE ITEMS

1. 6 1/3 − 2 2/3 = ___

   A 4 1/3
   B 4 2/3
   C 3 1/3
   *D 3 2/3

2. 2/3 × 3/8 = ___

   *A 1/4
   B 5/11
   C 9/16
   D 5/24

3. 2 5/8 + 6 6/8 = _____

   A 8 1/8
   B 8 3/8
   C 9 1/8
   *D 9 3/8

CONTENT

1. Fractions are expressed in the form a/b where a and b are whole numbers and b ≠ 0.

2. Fractions will have denominators of 2, 3, 4, 5, 6, 8, 10, 12, or 16 (responses may have other denominators). Emphasis will be placed on those denominators most commonly used in measurement situations (2, 4, 8, 16).

3. Mixed and whole numbers, if used, will be less than 10. The fractional part of a mixed number will be restricted as in #2.

4. Addition and subtraction of mixed numbers will require regrouping.

SUGGESTED NUMBER OF ITEMS

	Proper Fractions	Mixed Numbers
addition	1	1
subtraction	1	1
multiplication	1	1

QUESTION FORM

1. Proper fractions in addition and subtraction items will have unlike denominators; those in multiplication items may have like or unlike denominators.

2. Two mixed numbers will be included in addition items, and the fractional parts will have like denominators.

3. Either one or two mixed numbers will be included in subtraction items. If one, the other number will be a whole number; if two, the fractional parts will have like denominators.

4. A mixed number and a whole number, or a fraction and a whole number, will be included in multiplication items; i.e., two mixed numbers will not be used.

5. Proper fractions, or the fractional parts of mixed numbers, will be reduced to lowest terms.

RESPONSE FORM

1. The correct response will always be reduced to lowest terms.

2. An "unreduced" (but correct) response will not be used as a distractor. Other unreduced fractions may be used as distractors, however.

3. For addition and subtraction of fractions with unlike denominators, distractors will be included which result from simply adding or subtracting numerators and denominators, or from converting the denominators but not the numerators.

4. For multiplication and division of fractions, distractors will be included which result from failure to invert or improperly inverting, or from simply adding or subtracting numerators/denominators.

5. For problems with mixed numbers and whole numbers, some of the above distractors may be used; also, distractors will be included which result from operating on the whole numbers and disregarding the fractional parts of mixed numbers, or from treating fractions as two whole numbers.

SUBJECT: Mathematics
GRADE LEVEL: 7

COMPETENCY 7.12

The student will be able to determine the probability of a simple event.

BRIEF DESCRIPTION

The student is expected to be able to determine probabilities using relatively informal techniques based upon intuition and ability to compute with simple fractions.

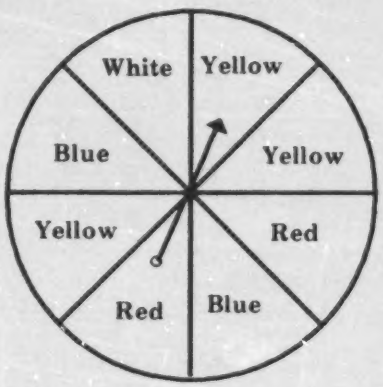
SAMPLE ITEMS

1. There are 6 marbles in a bag: 2 white, 1 red, 3 blue. Without looking, someone chooses a marble. What is the probability it will be a white marble?

   A 1/6
   B 1/2
   *C 1/3
   D 2/8

2. The probability that the spinner will stop on a yellow space is 3/8. If the spinner is spun 24 times, about how many times will it stop on a yellow space?

   A 3
   B 8
   *C 9
   D 11



3. How may different teams of two people can be formed from a group of four people?

   A 4
   *B 6
   C 8
   D 16

CONTENT

1. Probability is defined as the ratio of the number of favorable outcomes of an event divided by the number of possible outcomes of an event. The set of possible outcomes is called the sample space of the event.

2. A simple event is a single occurrence of an event (e.g., rolling a die) or successive repetitions of a single event where the outcome of a particular repetition is independent of the outcome of any previous occurrence of that event (e.g., rolling a die 3 times in succession).

3. The number of possible outcomes of a simple event will be 10 or less, whether that event occurs once or is repeated several times.

4. Problem types will include determining the expected number of favorable outcomes, determining the number of possible outcomes, and determining probabilities. Three specific types are included:

   a. Finding the probability of a single simple event when the sample space is given;

   b. Finding the estimated number of favorable occurrences of an event resulting from repetitions of the event when the probability of that single event is given (e.g., If the probability of drawing a spade from a full deck of cards is 1/4, about how many spades would you expect to get if you repeated this card-drawing 100 times?).

   c. Finding the number of possible outcomes by determining the number of different combinations or subsets, that can be formed from a set of objects. The number of possible combinations will be 8 or less.

5. It will be possible to solve problems intuitively or by making drawings, rather than by applying formulas.

6. Probabilities to be determined, or given probabilities, will be restricted to fractions with denominators less than or equal to 10. Probabilities will usually be expressed as fractions, but may be expressed as whole numbers (e.g., 1 out of 5).

SUGGESTED NUMBER OF ITEMS

simple probability, sample space given	3
estimate number of times an event will occur	2
determine number of combinations	1

QUESTION FORM

1. Problem settings will be based on common, concrete situations such as coinflips, drawing names or objects from a hat, bag, etc., spinning a spinner, choosing teams, and the like. Dice and playing cards will not be used since not all students are familiar with them and they are not considered appropriate in some school environments.

2. Drawings will be provided for some items.

RESPONSE FORM

1. The correct response for fractional probabilities may be unreduced or expressed in lowest terms.

2. Distractors for simple fractional probabilities will be based on various incorrect fractions formed with the numbers in the problem.

3. Distractors for problems involving estimating the numbers of times an event will occur will include responses based on one trial rather than on repeated trials.

4. Distractors for combination problems will include one or more of the numbers in the problem and the result of finding insufficient or extra combinations.

GRADE 10
MATHEMATICS ITEM SPECIFICATIONS

GENERAL ITEM SPECIFICATIONS

1. Readability will be <u>below</u> Grade 10 level.

2. Problem content, particularly word problems, will be of interest to and relevant for Grade 10 students.

3. Although scratch paper will usually be available, sufficient space to work will be provided in the test booklet.

4. Occasionally attributes of the question will also be applied to the responses and vice versa; for example, restrictions for labeling geometric figures generally apply whether the figure is a part of the question or a response.

5. Number size for operations will be limited by the restrictions below; however, solutions may necessarily exceed these maximums.

   <u>Whole numbers</u>:

   Addition:

   a. not more than 4 two-digit addends,
   b. not more than 2 three-digit addends,
   c. not more than 3 significant digits in 1 addend; e.g., 2 five-digit addends each with 3 significant digits is permissible.

   Subtraction:

   not more than 3 significant digits in the minuend or subtrahend.

   Multiplication:

   not more than a total of 4 significant digits in 2 factors.

   Division:

   a. not more than 4 significant digits in the dividend,
   b. not more than 1 significant digit in the divisor.

<u>Decimals</u>:

All operations:

the restrictions for operations with whole numbers apply; they refer to the <u>total</u> number of digits to the left and right of the decimal point. For example, 26.3 - .389 = ___ and 2600 - 3.89 = ___ are permissible, but 26.38 - .389 = ___ and 2.638 - .3891 = ___ are not.

Fractions:

All operations:

denominators will be restricted to 2, 3, 4, 5, 6, 8, 10, 12, and 16.

Division:

relatively prime denominators will be used only if less than 10.

Mixed Numbers:

All operations:

only numbers less than 10 with the fractional parts restricted as above will be used.

Signed Numbers:

All operations:

only numbers with absolute values less than or equal to 30 will be used.

6. Each competency will be measured by six test items.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.1

The student will be able to recognize equivalent representations of whole numbers, decimals, and fractions expressed in conventional notation, in exponential notation, or as percents.

BRIEF DESCRIPTION

The student is expected to be able to convert fractions, decimals, and percents from one form to another, and to convert whole numbers and/or decimals to and from exponential (scientific) notation.

SAMPLE ITEMS

1. The number .000042 written in scientific notation is _____.

   A 42×10^{-6}
   *B 4.2×10^{-5}
   C 42×10^{6}
   D 4.2×10^{5}

2. What is another name for .06?

   *A 6%
   B .06%
   C 60%
   D .6%

3. What is another name for 3/20?

   A 15
   B 1.5
   C .666
   *D .15

CONTENT

1. Problems will include:

   a. converting whole numbers or decimals to exponential (scientific) notation and vice versa,
   b. converting decimals to percents and vice versa,
   c. converting decimals to fractions and vice versa,
   d. converting fractions to percents and vice versa.

2. Place values of whole numbers and decimals to be represented in scientific notation will range from ten billions to hundred billionths; that is, in scientific notation, numbers will require powers of 10 from 10^{10} to 10^{-10}. Emphasis will be placed on very small or very large numbers since scientific notation is most commonly and conveniently used for such numbers.

3. Denominators of fractions to be converted to decimals and vice versa will be based on terminating decimals; that is, 2, 4, 5, 8, 10 or other denominators which have 2 and/or 5 as prime factors. Some very large denominators (e.g., 1,000; 10,000) will be used in order to incorporate place value notions (e.g., 7/10,000 = .0007). Some decimals will include a whole-number part (e.g., 3.5 = 35/10).

SUGGESTED NUMBER OF ITEMS

whole numbers/decimals ↔ exponential notation	1
decimals ↔ percents	2
fractions ↔ percents	2
decimals ↔ fractions	1

QUESTION FORM

1. Directions for converting a whole number or decimal to scientific notation will include the term scientific notation; that is, there are other correct expressions for numbers which include powers of 10. However, only an expression which places a decimal point after the first significant digit is scientific notation. For example:

   $2{,}820{,}000 = 2.82 \times 10^6$ (scientific notation)
   $2{,}820{,}000 = 282 \times 10^4$ (not scientific notation)

2. Directions for conversions from scientific notation to whole numbers or decimals, or for fraction/decimal equivalences will be, for example:

   a. What is another name for 8.3×10^{-6}?
   b. What is another name for 4/12?

3. Whole numbers in scientific notation will be expressed with a decimal point; e.g., 5.0×10^{-5}; not 5×10^{-5}.

RESPONSE FORM

1. Distractors for conversions to and from scientific notation will involve mislocated decimal points, miscounted zeroes, and exponents with the wrong sign. Counting total digits may be the basis of distractors also.

2. For fraction/decimal equivalences decimal distractors will involve decimal points when dividing, and decimals which result from inversion (dividing the denominator by the numerator). Other calculation errors will not be the bases of distractors.

3. Responses for fraction/decimal equivalences which are fractions may or may not be reduced; however, care will be taken to give only one correct fraction. Distractors will result from place value errors (e.g., .02 = 2/100) or from inversion errors (e.g., .02 = 100 ÷ 2 = 50/1), rather than from calculation errors.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.2

The student will be able to use the rules for order of operations to find a value for an expression.

BRIEF DESCRIPTION

The student is expected to be able to take a horizontal expression or string of numbers and operational symbols (+ , -, x, ÷), some of which may be enclosed within parentheses, and then determine the correct numerical value of that expression by carrying out the prescribed operations in the generally accepted correct order.

SAMPLE ITEMS

1. $6 - 2(1 - 3) \times 4 =$ _____

   A 40
   *B 22
   C 8
   D -10

2. $8 + 4^3 \div 2 + 6 =$ _____

   *A 46
   B 42
   C 16
   D 9

3. $5 \times 8 - 8 \div 4 =$ _____

   A 0
   B 8
   C 30
   *D 38

CONTENT

1. Signed numbers ranging from -12 to + 12 will be included.
2. Operations will include addition, subtraction, multiplication, division, and exponentiation.
3. Exponents will be restricted to squares and cubes.
4. Zero will not be used as a base.
5. Some expressions will not include parentheses.
6. Nested parentheses will not be used.

SUGGESTED NUMBER OF ITEMS

strings with parentheses	2	(1 should include exponents)
strings without parentheses	4	

QUESTION FORM

1. Each item will have 3 or 4 calculations; at least 2 of these will be different (not repeated) operations.

2. Some items will involve 3 or 4 different operations; i.e., no repeated operations.

3. Some items will involve only addition and subtraction, while others will involve only multiplication and division.

RESPONSE FORM

1. Distractors will reflect order of operation errors, not arithmetic errors.

2. Fractions may be used as distractors.

SUBJECT: Mathematics
GRADE LEVEL: 10

COMPETENCY 10.3

The student will be able to evaluate formulas, and to solve proportions, linear equations and inequalities with one variable.

BRIEF DESCRIPTION

The student is expected to be able to evaluate a commonly used formula by substituting given whole number values for the letters contained in the formula. The student is also expected to be able to solve linear equations involving at most three solution steps and to determine if a given numerical value is a possible solution to a linear inequality. Some of the linear equations may be in proportion form.

SAMPLE ITEMS

1. Solve for C where:

   $C = 5/9 (F-32)$, and $F = 104$.

   A 360
   B 129.6
   C 54.2
   *D 40

2. Solve for x.

   $3x - 2 = 10$

   A 36
   *B 4
   C 2 2/3
   D 3/8

3. Solve for n.

   $\frac{2}{n} = \frac{8}{32}$

   A 2
   B 4
   *C 8
   D 16

4. Which of the following is a solution to the inequality?

   $4n - 1 < 19$

   A 10
   B 8
   C 5
   *D 3

CONTENT

1. The skills included are:

   a. evaluating a formula for an unknown which stands alone on one side of an equal sign,
   b. solving a linear equation (or inequality) that involves at most three solution steps,
   c. solving proportions with positive integers.

2. Numbers will be restricted to two digits.

3. Formulas will be restricted to 4 or fewer variables and/or terms, including the variable to be solved for. Variables and constants should be positive integers except in special cases (e.g., pi = 3.14; C = 5/9 (F-32).

4. Only commonly used formulas, such as V = 1/3 Bh, will be included.

5. Equations and inequalities to be solved may have variables in more than one term or on both sides of the equation in some cases (e.g., 2x + 4 = 8x).

6. Exponents will be restricted to squares and cubes.

SUGGESTED NUMBER OF ITEMS

evaluate formulas	1
solve equations	2
solve inequalities	1
solve proportions	2

QUESTION FORM

1. A variety of alphabet letters, upper or lower case, may be used to represent variables. Preference is given to those letters that are commonly used in curricular programs.

2. Proportions will be in fractional form, such as A / B = C / X, rather than in words, such as "A is to B as C is to X."

3. Unknowns may be on either side of the equal sign.

4. Some formulas will include parentheses.

5. Rules for order of operations will not be the focus of these items; however, they will be involved necessarily in some items.

6. Inequalities may be strict or compound (e.g., less than, greater than or equal to).

RESPONSE FORM

1. Distractors for formula items will include:

   a. results of substitution errors,
   b. results of algebraic errors after correct substitutions are made.

2. Distractors for solving equations/inequalities and proportions will be based on algebraic errors, such as multiplying the wrong terms in a proportion.

3. Some distractors may be based on rules for order of operations.

4. Distractors resulting from "basic fact" errors will be deemphasized.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.4

The student will be able to identify similar and congruent figures and determine measures based on similarity and congruence.

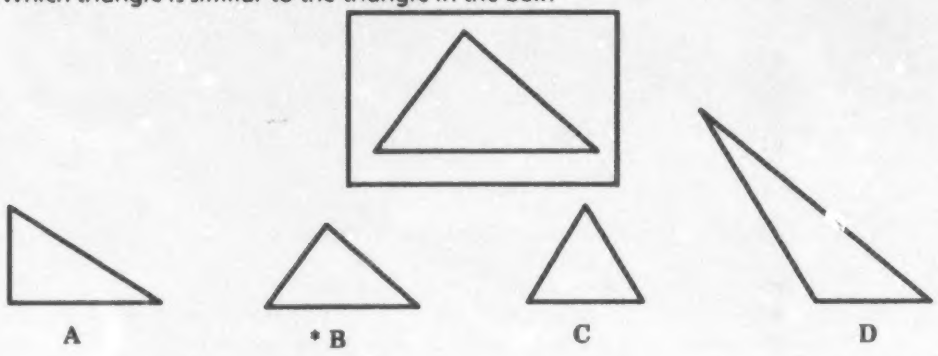
BRIEF DESCRIPTION

The student is expected to be able to demonstrate an understanding of the relationships of congruence and similarity by doing each of these:

1. identifying figures as congruent or similar,
2. identifying corresponding parts of congruent or similar figures,
3. determining the measure of corresponding parts of congruent or similar figures.

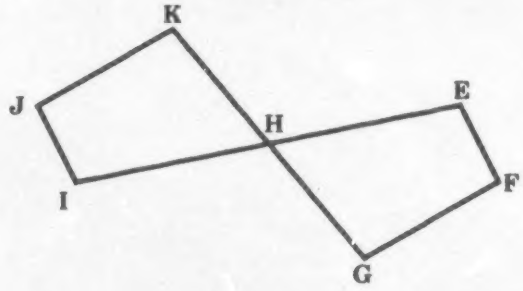
SAMPLE ITEMS

1. Which triangle is similar to the triangle in the box?



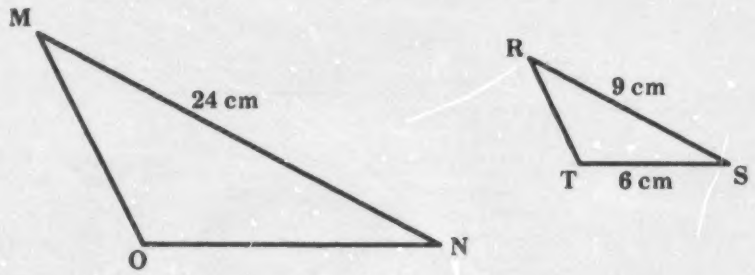
2. Quadrilateral EFGH is similar to quadrilateral IJKH. Which angle in EFGH corresponds to angle J in IJKH?

A E
*B F
C G
D H



3. Triangle MNO is similar to triangle RST. How long is segment NO?

A 14 cm
*B 16 cm
C 18 cm
D 36 cm



CONTENT

1. Problems will be based on similar and congruent triangles and quadrilaterals and will be of three types:

   a. identify figures as similar or congruent,
   b. identify corresponding segments or angles of similar or congruent figures,
   c. find the measure of corresponding segments or angles of figures that are similar or congruent.

2. Some problems for a. above will include measurements; some problems for b. above will include marks on corresponding parts. However, it will be possible to identify figures or corresponding parts <u>without</u> actually using the measurements or marks. That is, only informal notions of geometry will be required to answer the questions.

3. Measurements will usually be whole numbers less than or equal to 20.

SUGGESTED NUMBER OF ITEMS

identify figures	2
identify corresponding parts	2
find measures of corresponding parts	2

QUESTION FORM

1. Most items will include figures that will be placed in various orientations.

2. Words rather than symbols should be used, e.g., congruent, not $\cong$; angle, not $\angle$.

3. All alphabet letters will be used, not just A, B, C, D. The convention of using contiguous letters (e.g., J, K, L, M, not J, S, T, W) will be followed.

4. Abbreviations for units of measure may be used. Only one unit will be used in each problem and no conversions will be involved.

RESPONSE FORM

1. All responses will represent the same geometic attributes; e.g., if an angle should be identified, a segment should not appear as a distractor.

2. All units of measure will be the same unit as the stem. Labels (or abbreviations) will also be the same.

SUBJECT: Mathematics
GRADE LEVEL: 10

COMPETENCY 10.5

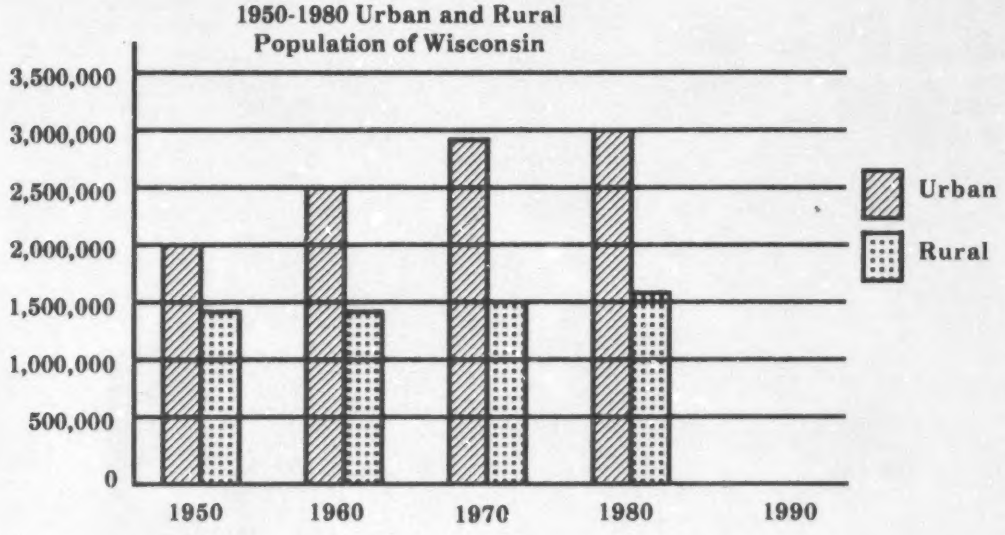
The student will be able to read, interpret, and make inferences from tables and graphs.

BRIEF DESCRIPTION

The student is expected to be able to extract one or more pieces of data from a graph or table, to be able to relate those data to each other or to other information or questions contained in a problem, or to be able to use those data to make a prediction or inference.

SAMPLE ITEMS

1. If population trends continue, what is a reasonable estimate of the rural population in 1990?



A 1,500,000
*B 1,700,000
C 2,300,000
D 2,500,000

2. How much more were Wisconsin cash receipts for dairy products in 1980 than in 1976?

Wisconsin Cash Receipts From Livestock , 1976-1980
(in thousands of dollars)

Commodity	1976	1977	1978	1979	1980
Meat Animals	$520	$500	$670	$840	$810
Dairy Products	1,810	1,890	2,130	2,500	2,760
Poultry and Eggs	110	120	120	120	120
Misc. Livestock	30	40	50	50	50
Total	$2,470	$2,550	$2,950	$3,530	$3,740

A $2,760,000
*B $ 950,000
C $1,810
D $ 950

CONTENT

1. There is not an absolutely clear-cut distinction among the skills of reading, interpreting, and making inferences from tables and graphs, but they may be generally defined as follows:

   a. Reading involves finding and reading a specified number or numbers from a particular cell or point. For a graph, the number to be read may be on either the horizontal or vertical axis. Interpolation can be considered to be a type of reading of a table or graph.
   b. Interpreting involves finding and reading one or more numbers or the entire table or graph in order to answer a question relating the numbers in some way; e.g., which state has the most people per square mile? or, how many more people live in x than y? A calculation to determine another value given in the problem statement may be involved. Responses may be a number or not; often they will be values or labels from the axes of a table or graph.
   Reading problems tend to focus on one or two cells, bars, or points, while interpretation problems involve examining an entire table or graph.
   c. Inferring involves examining an entire table or graph in order to make a generalization, to note a trend, to draw a conclusion, or in some other way to summarize and go beyond the immediate information and interpretation of the information in the table or graph. For example, if the trend in the population continues, which age group will be largest in year X? Extrapolation is often but not necessarily involved in inferences.

2. Graphs will be horizontal and vertical bar graphs with single, double, or triple bars; circle graphs; or line graphs with one, two, or three lines. Pictographs will not be included.

   Bar and line graphs will have:

   a. numbers with 3 or fewer significant digits; large numbers will be used in some cases;
   b. all marked intervals labeled in some cases; and one or more unmarked intervals between marked intervals in some cases;
   c. horizontal axes not always representing zero;
   d. bars and points both on and not on interval marks or intersections;
   e. keys for problems with more than one bar/line.

   Circle graphs will have some percents which are not whole numbers.

3. Tables will:

   a. have whole numbers or decimals with 4 or fewer significant digits (some large numbers will be used);
   b. be two-dimensional;
   c. contain a maximum of 50 cells;
   d. include totals for rows and columns when relevant.

4. Some problems will require simple interpolation or extrapolation; in some cases the extrapolation or interpolation will be the sole purpose of the item.

SUGGESTED NUMBER OF ITEMS

graphs		4		read	2
To include:			and	interpret	3
bar	at least	1		infer	1
line	at least	1			
circle	at most	1			
tables		2			

QUESTION FORM

1. Tables and graphs will be titled and both axes/dimensions will be clearly labeled.
2. Each item will have a separate table or graph; however, the same table or graph may be used in more than one item.
3. Units of measure, and abbreviations and symbols, may be used.
4. Interpolation and extrapolation items will be as unambiguous as possible.

RESPONSE FORM

1. Distractors for interpretation and inference items will include values or conclusions determined by insufficient examinations of a table or graph, i.e., using only one dimension or one line, or reading only some of the points. Distractors may also be based on calculation errors.
2. If units of measure are used, distractors will not be based on incorrect or alternative units.
3. Distractors for graphs will be clearly wrong; they will not depend on students' visual acuity.
4. Some distractors for interpolation and extrapolation items will be the results of directly reading nearby values.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.6

The student will be able to use addition, subtraction, multiplication, and division to solve problems in applied situations.

BRIEF DESCRIPTION

The student is expected to be able to analyze one- or two-step verbal arithmetic problems (including proportional or rate problems), decide which operation(s) to use in order to solve, and then carry out that (those) arithmetic computation(s) to determine an answer.

SAMPLE ITEMS

1. A package of 5 pencils costs $1.95. One pencil sold separately costs 45¢. How much do you save by buying the package rather than 5 pencils one at a time?

   A $2.25
   B $1.50
   C 39¢
   *D 30¢

2. A road map of Wisconsin has a scale in which 10 centimeters represents 75 kilometers. If the distance from Beecher to Plymouth on the map is 25 centimeters, approximately what is the actual distance from Beecher to Plymouth?

   A 1875 kilometers
   B 333.3 kilometers
   C 300 kilometers
   *D 187.5 kilometers

3. A family bought a color TV set for $484. They paid $100 in cash and the rest in 24 equal payments. No interest was charged. How much was each payment?

   A $11.06
   *B $16.00
   C $20.17
   D $24.30

CONTENT

1. Problems will be routine word problems that involve:

   a. at least two steps which may require two different arithmetic operations or the same operation used several times;
   b. ratio and proportion (as a special case of two-step problems).

2. Ratio/proportion problems will include both solving proportions and comparing two rates.

3. Ratio/proportion problems may cover, but not be necessarily restricted to, the following:

   a. best buy,
   b. miles per gallon,
   c. general rates such as recipe conversions, scale drawings, pay, cost of goods.

4. With the exception of scale and money problems, conversions will not be involved in problems with a measurement context.

5. Some problems will involve a step (operation) beyond determining the rate; e.g., a question such as "how much is saved by buying X rather than Y?" will be asked.

SUGGESTED NUMBER OF ITEMS

general multi-step	2
ratio and proportion	4

QUESTION FORM

1. Numbers will be selected within the restrictions stated in the General Item Specifications for multiplication and division. They will be realistic, yet simple enough that arithmetic proficiency is deemphasized as a source of error. Calculations will be made convenient by the use of numbers which are multiples of 10 or 100, numbers which do not result in remainders or continuing decimals, etc.

2. Some items will involve a unit rate which is not a whole number.

RESPONSE FORM

1. Distractors will be the results of errors in setting up ratios, or of operating on some but not all of the needed numbers in the problem, or of not answering the question asked (a partial solution).

2. Distractors which result from computational errors may be used, but will be deemphasized.

3. If a measurement context is involved, all responses will be labeled with the same unit of measure. (Exception: money)

SUBJECT: Mathematics
GRADE LEVEL: 10

COMPETENCY 10.7

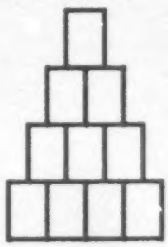
The student will be able to solve problems that can be solved by procedures such as looking for a pattern, constructing a table, using guess and check procedures, or making a drawing.

BRIEF DESCRIPTION

The student is expected to be able to solve nonroutine problems by using a variety or combination of nonalgorithmic procedures. Nonroutine problems are not "tricky" problems, but can be described as being not of the standard "application" story problem types that often appear as exercises in textbook sections following instruction in some computational skill.

SAMPLE ITEMS

1. A student has collected 32 soda cans and wants to stack them in rows to form a triangular shape as in the picture. If he makes a complete triangle with as many cans as possible, how many cans will be left over.



A 25
B 11
*C 4
D 0

2. All 30 students in the 10th-grade homeroom joined the band or orchestra or both. 16 students joined the band. 12 students joined both the band and the orchestra. How many students joined the orchestra?

A 14
B 18
*C 26
D 28

3. 11 boys are standing in a circle. No two boys who are standing next to each other are wearing the same color shirt. What is the smallest number of different shirt colors the boys could be wearing?

A 2
*B 3
C 4
D 5

CONTENT

1. Problems will require the student to use more than immediate recall or previously established routine solution procedures or algorithms. In contrast, a routine problem in one for which the student has been taught a method of solution so he/she knows immediately or with little effort how to proceed to find the solution.

2. Problems will be limited to those that are most likely to be solved by the application of one or more of the following problem-solving strategies:

   a. using guess and check procedures,
   b. looking for a pattern,
   c. constructing a table,
   d. making a drawing.

   It must be recognized that these strategies are not mutually exclusive. It should also be emphasized that a student does not have to use one of these four strategies.

3. Number sizes and operations will be restricted according to General Item Specifications. Actually, little, if any, calculation will be required.

SUGGESTED NUMBER OF ITEMS

Each item will have a strong potential for encouraging the use of at least one of the strategies. However, since more than one strategy will often be usable, no specific numbers of problems are suggested.

QUESTION FORM

1. There will be a problem statement which includes data, a drawing, or a description of a situation.

2. A question will be asked.

3. The problems will not require the manipulation of large amounts of data (i.e., 25 total entries) and will have no more than 3 variables or 3 given conditions.

RESPONSE FORM

1. Distractors will include answers obtained by wrong applications of a strategy, such as not counting all possibilities, determining the wrong pattern, not satisfying a condition of a problem.

2. Distractors based on errors in calculation will be used sparingly.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.8

The student will be able to calculate the length, perimeter, area, volume, or angle measure of common geometric figures.

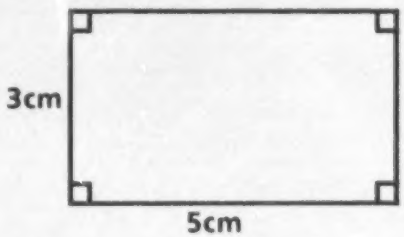
BRIEF DESCRIPTION

The student is expected to be able to use common geometric formulas and relationships to determine measurements of two- and three-dimensional figures. Dimensions of figures, or parts of figures, to be used will be given in the problems and will consist of whole numbers.

SAMPLE ITEMS

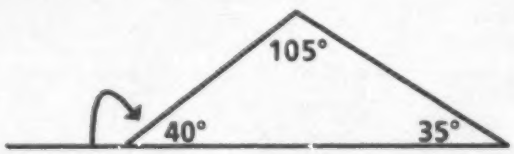
1. What is the area of this figure?

   A 8 cm^2
   *B 15 cm^2
   C 16 cm^2
   D 64 cm^2



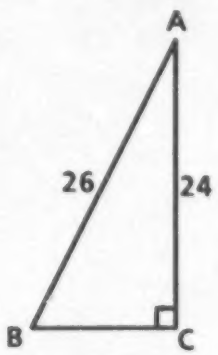
2. What is the measure of the angle shown by the arrow?

   A 40°
   B 50°
   C 75°
   *D 140°



3. What is the length of side BC of triangle ABC?

   A 22
   B 18
   C 12
   *D 10



CONTENT

1. Geometric attributes and figures covered are:

   a. lengths (including segment, diagonal, perimeter, circumference, diameter, radius) of quadrilaterals, regular polygons, triangles, circles;
   b. areas of quadrilaterals, triangles, circles, and surface areas of cubes, rectangular prisms, triangular prisms;
   c. volumes of cubes, rectangular prisms, cylinders;
   d. angle measures of triangles (interior corner angles), circles (central angles), and lines (complementary, supplementary angles).

2. Knowledge of all concepts or formulas associated with the above attributes will be assumed. This includes the Pythagorean theorem.

3. Dimensions of figures will be whole numbers with no more than 2 significant digits.

4. Both metric and nonmetric units will be included.

5. Conversions within systems (e.g., cm to m), and from metric to nonmetric, will not be included.

SUGGESTED NUMBER OF ITEMS

length	1
area	1
surface area	1
volume	1
angles	1
Pythagorean theorem	1

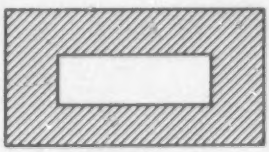
QUESTION FORM

1. A drawing will usually, but not always, be provided.

2. Drawings will be clearly labeled with appropriate dimensions. Abbreviations (in.) and symbols (cm) may or may not be used.

3. The value of pi (π) to use will be given unless a particular item asks for an estimated answer. Note that the formula itself will not be given.

4. Some problems will involve two figures (or formulas); e.g., area of shaded part in:



RESPONSE FORM

1. Distractors will include the results of finding the measures of wrong attributes (applying wrong formulas), e.g., area instead of volume.

2. Distractors will include the results of errors in formulas, e.g., $A = \pi d^2$.

3. Distractors for angle measure will include the results of erroneous assumptions, e.g., the sum of angles of a triangle is 90°.

4. All responses will be labeled with the same units of measure (even though some distractors are actually numbers in a different unit).

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.9

The student will be able to order a given set of real numbers.

BRIEF DESCRIPTION

The student is expected to be able to take a set of numbers -- whole numbers, fractions, decimals, signed numbers, or a mixture of these -- and put them in order from smallest to largest, or to choose the largest or smallest number in that set. Sets are limited to four numbers or less.

SAMPLE ITEMS

1. Which of these numbers is the smallest?

   A $\sqrt{6}$

   *B $\sqrt{2}$

   C 4

   D 2

   $2, 4, \sqrt{2}, \sqrt{6}$

2. Which list has the numbers -6, 0, -16, 6 in order from least to greatest?

   A 0, 6, -6, -16
   B -16, -6, 6, 0
   C -16, 0, 6, -6
   *D -16, -6, 0, 6

CONTENT

1. This skill involves ordering a given subset of numbers within a set of real numbers or choosing the largest (smallest) from a set. The subsets included will be:

   a. whole numbers less than 10,000;
   b. signed numbers -20 to 20;
   c. fractions, denominators 2, 3, 4, 5, 6, 8, 10, 12, 16;
   d. decimals, to thousandths;
   e. radicals of two forms:
      1. common square roots in which the radicand is a whole number less than 100 and the root is a positive integer, e.g., $\sqrt{25}$
      2. irrationals, square roots in which the radicand is a whole number less than 10, e.g., $\sqrt{2}$

2. Emphasis will be placed on ordering subsets as "narrowly" or commonly defined, rather than on ordering general subsets; for example, more problems will involve all fractions (1/2, 3/4, 2/3, 4/5) than will involve a mix of fractions, decimals, and whole numbers (1/2, .75, 66 2/3, 80).

3. The use of symbols (<, >, =, ≥, ≤) will be deemphasized.

SUGGESTED NUMBER OF ITEMS

all positive whole numbers	1		order a set	4
all signed numbers	1	and	choose largest	
all fractions	1		or smallest	2
all decimals	1			
mixed subsets	2			

QUESTION FORM

1. Problems could involve either ascending or descending order; however, to avoid confusion most items will be in the order usually used (ascending).

2. The same item will not involve numbers which are equivalent (e.g., 1/4, .25) unless the notion of equivalence is central to that particular item.

RESPONSE FORM

1. Distractors will not include "correct" descending order if the stem directs that the numbers be put in ascending order. For example, both -8, -6, -2, 2 and 2, - 2, -6, -8 will not be used. (The purpose of the items is not to check whether students know the difference between left to right and right to left ordering, but rather whether they know the relative sizes of the numbers no matter in which direction they are ordered.)

2. Distractors may include equivalent numbers.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.10

The student will be able to determine the outcome of an algorithm (e.g., set of instructions, flow chart, and program) or modify an algorithm to produce a specified outcome.

BRIEF DESCRIPTION

The student is expected to be able to deal with a set of routine instructions (presented in ordinary conversational language, or in the form of a flow chart, or written as a computer program) and to determine what the outcome of those instructions would be for some given input, or to decide how to change the instructions in order to modify the outcome.

SAMPLE ITEMS

1. What will be the outcome of the procedure for these names:

   Anne, Joshua, Rachel, Adam, Anna?

Procedure
1. Make N equal to 0.
2. Take a name from the list.
3. Does the name start with the letter A? If yes, go to step 5. If no, go to step 4.
4. Are there more names? If yes, go to step 2. If no, go to step 7.
5. Add 1 to the number you have in N.
6. Are there more names? If yes, go to step 2. If no, go to step 7.
7. Write the number you have in N and stop.

   A Adam, Anna, Anne, Joshua, Rachel

   B Anne

   C 5

   ***D** 3

CONTENT

An algorithm is defined as a step-by-step description of operations on inputs carried out in order to produce an outcome.

1. Three different forms of algorithms are considered:

   a. a set of instructions written in conversational language, such as those in a tax form, a recipe, or rules to a game;
   b. a flow chart which is a diagram using standard forms representing different types of operations or decisions, such as a representation of a computer program or of a process for determining a value of a function;
   c. a computer or calculator program using an abbreviated form of English or a common computer language such as Basic.

2. Algorithms will be restricted to no more than 10 steps, excluding START and STOP instructions. No more than two decision steps will be included. No more than two loops, either sequential or nested, will be included.

3. Algorithms will be mathematically oriented, requiring some knowledge of mathematical content normally taught in grade 9 or before. Number size for operations, if any, will be restricted according to the General Item Specifications.

SUGGESTED NUMBER OF ITEMS

form a	3		determine outcome	4
form b	2	and	modify algorithm	2
form c	1			

QUESTION FORM

1. Steps of the algorithm will be listed and the input given. The question will be "what will be the output?"

2. A complete algorithm will be given. Students will be asked which step should be changed to produce a different outcome from the one the given algorithm would produce.

RESPONSE FORM

1. When an output is requested, the correct number or response will be given. The distractors will be outputs from steps incorrectly performed.

2. When an instruction or step in an algorithm is to be modified, the correct response will be given. The distractors will be plausible instructions which would not produce the specified outcome.

SUBJECT: **Mathematics**
GRADE LEVEL: **10**

COMPETENCY 10.11

The student will be able to solve problems in applied situations involving percent.

BRIEF DESCRIPTION

The student is expected to analyze a verbal arithmetic problem dealing with percent relationships, to make necessary conversions to fractions or decimals, and then to compute the answer to the problem.

SAMPLE ITEMS

1. A jacket which originally cost $120 is now on sale for $96. What is the percent of discount?

   A 12.5%
   *B 20%
   C 24%
   D 80%

2. The cost for a meal in a restaurant is $9.00. If you want to leave a 15% tip, how much money should you leave?

   A 15¢
   B 60¢
   *C $1.35
   D $1.66

3. A store advertises that its $360 price for a camera is 20% lower than the price at another store. What is the price of the camera at the second store?

   *A $450
   B $432
   C $400
   D $ 72

CONTENT

1. All percent problems will be in one of the three forms:

   a. Find a percent of a number:
   b. Find what percent a number is of another number;
   c. Find a number given a percent of that number.

2. Percents will be whole numbers; generally, they will be less than 100 and multiples of 5. Particular problem situations may dictate other percents, however. If a percent is larger than 100, it will be a multiple of 25.

3. Numbers in problems will be whole numbers (except for money).

4. Some problems will involve two operations; i.e., they will be two-step problems.

5. If a measurement context is used, conversion will not be involved (except for money).

SUGGESTED NUMBER OF ITEMS

find percent of number	2
find what percent number is of number	2
find number given percent	2

QUESTION FORM

1. Problems asking to find a number when a percent of the number is given will not be artificial; that is, it should be likely that the numbers in question in these problems will not be known.

2. Numbers will be selected carefully so that arithmetic proficiency cannot be the source of error.

RESPONSE FORM

1. Distractors will include the results of using multiplication when division is appropriate and vice versa.

2. Distractors for two-step problems will include the results of partial solutions.

3. Distractors which result from computational errors may be used, but will be deemphasized.

4. Responses for items in a measurement context will all be labeled with the same units (except for money).

SUBJECT: Mathematics
GRADE LEVEL: 10

COMPETENCY 10.12

The student will be able to determine the probability of a simple event and to use elementary statistics to describe data.

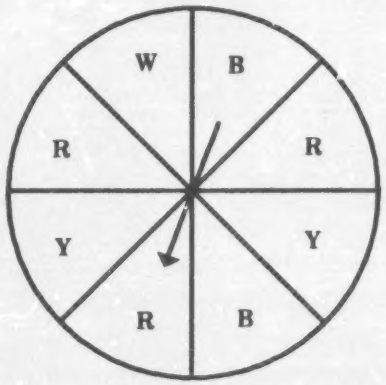
BRIEF DESCRIPTION

The student is expected to be able to determine probabilities using relatively informal techniques based upon intuition and ability to compute with simple fractions. The student is also expected to be familiar with statistical notions such as mean (average), median, and range and to use those notions to describe small data sets. Sophisticated computational ability is not required.

SAMPLE ITEMS

1. If someone spins the spinner, what is the probability that it will stop on the letter R?

A 1/6
*B 3/8
C 6/8
D 1/16



2. What is the median of the numbers in the box?

A 84
*B 81
C 79
D 69

70, 84, 85, 69, 80, 84, 81

3. Which measure best represents the typical temperature at 8 a.m. during the week?

A mean
*B median
C range
D There is no one best measure.

Temperature at 8:00 a.m.

Day	Temperature
Sunday	5°
Monday	4°
Tueday	35°
Wednesday	40°
Thursday	36°
Friday	45°
Saturday	40°

CONTENT

1. The areas of probability covered are:

   a. probability of a single simple event when sample space is given; e.g., finding the probability of a particular event occuring in a single trial when the number of possible outcomes is 10 or less;
   b. probability of a simple event occuring in a single trial when sample space is not given;
   c. simple conditional probability of independent events, that is, the notion that the probability of an independent event is not affected by repetition of that event through several trials, or by its being part of a compound event consisting of several events;
   d. combinations; that is, the number of different possible combinations that can be formed from the members of a set. The number of possible combinations will be less than 30. (This is different from actually determining the probability of a particular combination.)

2. It will be possible to solve probability problems intuitively or by making drawings, as well as by applying formulas.

3. Probabilities to be determined, or given probabilities, will be restricted to fractions with denominators less than 100. Emphasis will be on denominators less than 10. Probabilities will usually be expressed as fractions, but may be expressed as whole numbers (e.g., 2 out of 5).

4. Statistical problems will be of two types:

   a. given a set of data, the mean, median, or range must be calculated or determined (the data need not be ordered in size);
   b. given a set of data, a decision must be made about which measure or measures (mean, median, range) best represent the data.

5. The term and concept "average" will be included.

6. Numbers will be whole numbers with 3 or fewer significant digits.

SUGGESTED NUMBER OF ITEMS

probability	3
statistics	
mean, median	2
range	1

QUESTION FORM

1. Probability problem settings will be based on common, concrete situations such as coin flips, drawings of names or objects from a hat or bag, spinning of spinners, choosing of teams, and the like. Dice and playing cards are not used since not all students are equally familiar with them and they are not considered appropriate in some school environments.

2. Drawings will be provided for some items.

3. The data for statistical problems may be "real" (e.g., salaries, scores) or simply a set of numbers (20, 62, 84, 62, 60).

4. Some problems for average or mean may involve data which is already summed to give a total; e.g., if $100,000 was contributed by 350 people, what was the average contribution?

5. Numbers for data will be selected which, when a mean is calculated, result in a whole number; in general, numbers will be selected so that arithmetic proficiency cannot be the source of error.

6. Numbers for data will be selected carefully so that responses cannot be arbitrary; e.g., the mean and median will not be equal to the same value unless this is relevant to (or definitely irrelevant to) the problem. There will be a clear distinction between the mean and median for problems in which the best representation of the data is to be selected.

RESPONSE FORM

1. For probability items:

   a. The correct response, if a fraction, may be unreduced or expressed in lowest terms;

   b. Distractors, if fractions, may be based on various incorrect ratios formed by the numbers in the problem;

   c. If repeated trials are involved, some distractors (fractions) will be based on one trial rather than on repeated trials;

   d. Distractors for combination items will include the results of finding extra or insufficient numbers of combinations, given numbers, and possibly, of other operations with given numbers (e.g., adding them).

2. Usually, all three measures (mean, median, and range) will be the response choices; actual values or the terms may be used as appropriate.

3. The sum of the data will be used as a distractor for some items.

4. Distractors will not be based on calculation errors.